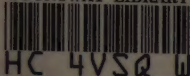


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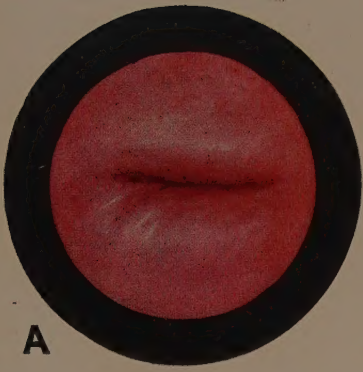
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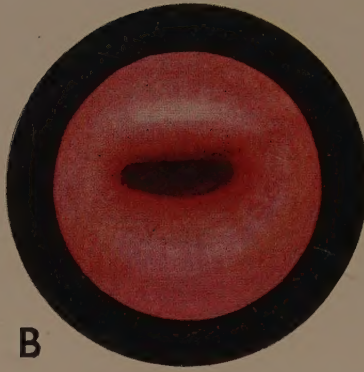
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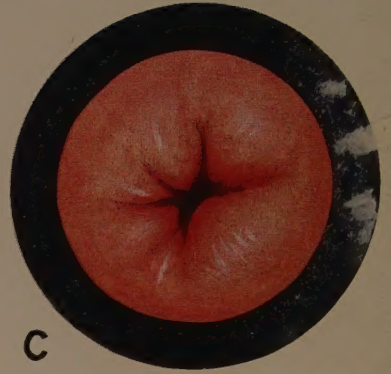
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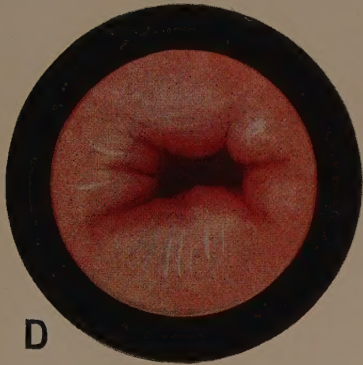
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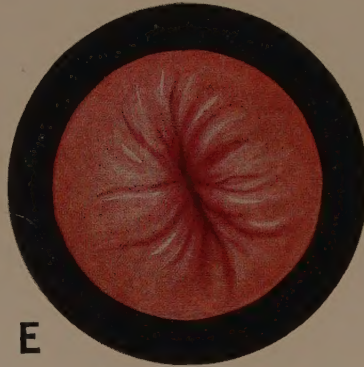
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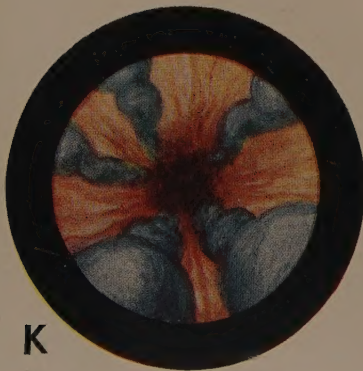
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PLATE I

APPEARANCES OF VARIOUS NORMAL AND ABNORMAL CONDITIONS AS SEEN ON ŒSOPHAGOSCOPY

- FIG. A.—The normal hypopharynx at the level of the crico-pharyngeal muscle, showing the resistant area in front due to the cricoid cartilage and the normal state of closure of the mouth of the œsophagus due to the tone of the crico-pharyngeal sphincter. (P. 42.)
- FIG. B.—The mouth of the œsophagus, *i.e.* same level as Fig. A, as seen at the moment of deep inspiration or on deglutition. (P. 42.)
- FIG. C.—The inferior cervical region of the œsophagus, showing incomplete closure of the lumen, but relative narrowing at the level of the upper aperture of the thorax due to the crowding together of the anatomical structures in this region. Note: This is the commonest site of impaction of foreign bodies in the œsophagus. (P. 42.)
- FIG. D.—Normal endoscopic appearance of the œsophagus in the thoracic region. On œsophagoscopy in this region the lumen is seen to vary with respiration. As the œsophagoscope passes downwards the lumen must be kept in view by lowering the head end of the table. (P. 42.)
- FIG. E.—At the level of a normal cardiac sphincter. Typical slit-like appearance. (P. 42.)
- FIG. F.—Foreign body. Portion of a tooth-plate impacted in the œsophagus at the level of the upper aperture of the thorax, removed perorally in less than two minutes. (P. 61.)
- FIG. G.—Cardiospasm. At the level of the cardiac sphincter in a case of cardiospasm. Congested rosette-like appearance. (P. 84.)
- FIG. H.—Pouch. The orifice of a hypopharyngeal diverticulum, showing spasmodic constriction of the mouth of the œsophagus. Note: It is not always possible to see both orifices at the same time, but it was done both in this case and that depicted on page 111. (P. 108.)
- FIG. I.—Simple tumour. Endoscopic appearance of a simple polypus of the œsophagus satisfactorily removed by means of an œsophagoscope. (P. 135.)
- FIG. K.—Varicose veins. Endoscopic appearance of the lower end of the œsophagus, in a patient with cirrhosis of the liver and œsophageal obstruction, showing dilated and tortuous varicose veins and chronic œsophagitis. Case described in the text. (Pp. 138 and 139.)
- FIG. L.—Tuberculosis of the œsophagus with marked narrowing of the lumen. (P. 140.)
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THE CHANGES OF VARIOUS KINDS AND ABNORMAL CONDITIONS
SEEN ON LARYNGOSCOPY

Fig. 1. The normal larynx at the level of the epiglottis. The epiglottis is seen as a broad, leaf-like structure, the base of which is attached to the hyoid bone. The aryepiglottic folds are seen as two small, rounded structures on either side of the epiglottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the epiglottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the epiglottis.

PLATE I

Fig. 2. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 3. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 4. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 5. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 6. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 7. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

Fig. 8. The normal larynx at the level of the glottis. The glottis is seen as a narrow slit between the vocal folds. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis. The aryepiglottic folds are seen as two small, rounded structures on either side of the glottis.

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ŒSOPHAGEAL OBSTRUCTION

ITS PATHOLOGY, DIAGNOSIS AND TREATMENT

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BY

^c
A. LAWRENCE ABEL

M.S. (LOND.), F.R.C.S. (ENG.)

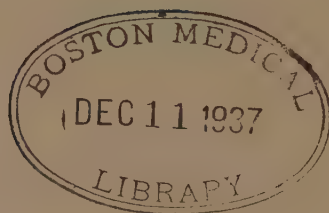
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PREFACE

THE importance of the subject of Œsophageal Obstruction may, in one way, be estimated by the fact that many thousands of individuals die every year in England alone from various forms of obstruction of the œsophagus.

In order that an exposition of the subject may be made clear, I have considered it advisable to deal first with the anatomy and physiology of the œsophagus, as so many of the factors which are concerned with the pathogenesis of œsophageal obstruction, and also the physical signs and symptoms which they produce, are dependent upon these two underlying principles.

Certain general methods in use are described together, thus avoiding needless repetition.

Those details of pathology, diagnosis, and treatment, which are unique in that they apply to only one type of œsophageal obstruction, are referred to in the later sections of the work under their appropriate headings.

The bibliography consulted is given at the end of each corresponding section.

The work is in substance the Essay to which the Jacksonian Prize was awarded by the Royal College of Surgeons in 1925. The Essay was completed in December 1924; since then it has been entirely revised and portions have been rewritten, and such new matter has been introduced as was required to bring the work up to date. I have also included a Hunterian Lecture which I delivered at the Royal College of Surgeons in February 1926.

The Essay was written while I was Surgical Registrar at the Cancer Hospital, where I did a considerable amount of experimental work upon animals with reference to the surgery of the thoracic œsophagus. Some of my conclusions are incorporated in the text.

My very best thanks are due to the Staff of the Cancer Hospital for allowing me to make the fullest possible use of records, experimental laboratories, and a large number of œsophageal cases for over five years.

I also wish to record my gratitude to numerous colleagues and friends for the use of clinical material and radiograms, especially, in addition to the Staff of the Cancer Hospital, Dr. E. Ulysses Williams, O.B.E., and Mr. Eric Young. For invaluable help with the arduous secretarial work and proof reading I am deeply indebted to Miss L. M. Hawksley, M.B., B.S., Miss C. M. Curry, B.A., and to Mr. T. J. Shields, Assistant Librarian at the Royal Medical Society, for so carefully preparing the Index.

The coloured and many of the other illustrations are the work of Mr. S. A. Sewell, and I am indebted to him for the care he has expended upon them.

For permission to quote my articles in current medical journals I am most grateful to the Editors of the *Lancet* and the *British Medical Journal*, and to the publishers of the *British Journal of Surgery* (Messrs. John Wright & Sons, Bristol).

My thanks are also due to Messrs. Falconer's Government, Law, and General Printing Works for permission to quote from the *Transactions of the Royal Academy of Medicine of Ireland*.

For the use of blocks illustrating various instruments I wish to express my sincere thanks to Messrs. Down Bros., Messrs. Arnold & Sons, Messrs. The Genito-Urinary Manufacturing Company, and MM. Drapier et Fils.

My best thanks are due to the Council of the Royal College of Surgeons for permission to publish the Essay, and to the Oxford University Press for the great care and trouble they have expended.

A. LAWRENCE ABEL.

48 HARLEY STREET, W.1.

January 1929.

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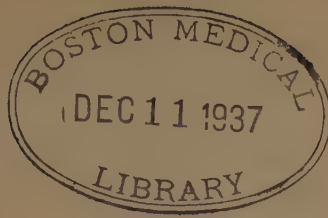
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ŒSOPHAGEAL OBSTRUCTION

CHAPTER I

ANATOMICAL AND EMBRYOLOGICAL CONSIDERATIONS

ANATOMICAL CONSIDERATIONS

THE ŒSOPHAGUS

THE Œsophagus is a narrow muscular tube extending from the lower border of the pharynx to the cardiac orifice of the stomach.

Course.—It begins at the level of the lower border of the cricoid cartilage opposite the body of the sixth cervical vertebra in the mid-line. It traverses the lower part of the neck, the superior and posterior mediastina, the Œsophageal opening in the diaphragm, which it pierces opposite the lower part of the tenth thoracic vertebra, and entering the abdomen it almost immediately joins the stomach opposite the eleventh thoracic vertebra, four inches behind the left seventh costal cartilage, and one inch to the left of the median plane.

Boundaries.—The upper boundary of the Œsophagus is marked on the outside by the lower border of the inferior constrictor muscle of the pharynx. On the inside there is no definite line of demarcation between the Œsophagus and the pharynx.

The lower boundary is well marked on the left side, where the wall of the Œsophagus makes a sharp angle with that of the stomach, termed the cardiac notch. The right border of the Œsophagus, however, passes gradually into the lesser curvature of the stomach. On the inner aspect the boundary is marked on the left side by a valvular fold which corresponds to the cardiac notch and projects into the stomach; it is formed by the apposition of the left wall of the Œsophagus and the right wall of the fundus of the stomach. This is termed the cardiac valve, but it has no valvular function. The junction is further marked by a distinct change in the colour of the mucous membrane, from pink in the Œsophagus to a reddish colour in the stomach; and also by a wavy or dentate line marking the transition from the squamous epithelium of the Œsophagus to the columnar epithelium of the stomach.

In its course downwards the Œsophagus does not run vertically but presents curves both in the lateral and the antero-posterior planes. Laterally, two curves

are found with their convexity directed to the left, while between the two the œsophagus presents a convexity towards the right; it also shows a general antero-posterior curve from above downwards, in conformity with the curve of the vertebral column.

The upper lateral curve begins at the level of the lower border of the cricoid cartilage, attains its maximum distance from the mid-line at the level of the third thoracic vertebra—where it projects from one-sixth to one-quarter of an inch beyond the left border of the trachea—and reaches the mid-line again at the level of the fourth thoracic vertebra.

The lower curve is longer and more marked than the upper; it begins at the level of the seventh thoracic vertebra, passes to the left and also slightly forwards so that at the level of the eleventh thoracic vertebra, where it joins the stomach, it is from three-quarters of an inch to one inch from the mid-line, and about an inch in front of the plane on which it started.

Dimensions.—The average length of the œsophagus is 25 cms. (10 inches), but may be from 5 to 10 cms. (2 to 4 inches) longer than the average.

The breadth varies at different levels, the tube showing five constrictions in its course:

(1) At the level of the lower border of the cricoid cartilage, *i.e.* at the upper orifice; here the transverse and sagittal diameters are 23 mms. and 17 mms. respectively.

(2) At the level of the upper aperture of the thorax there is a definite narrowing of the œsophagus, produced by the crowding together of the numerous organs on either side and in front of it. This is the level where foreign bodies are most frequently arrested.

(3) Where the œsophagus is crossed by the arch of the aorta, at the level of the fourth thoracic vertebra, the measurements are 24 mms. and 19 mms.

(4) Where the œsophagus is crossed by the left bronchus, at the level of the fifth thoracic vertebra, the measurements are 23 mms. and 17 mms.

(5) Where the œsophagus passes through the hiatus in the diaphragm the measurements are 25 mms. and 24 mms.

The dimensions of the intervening portions vary from 26 mms. to 30 mms., the abdominal portion being the largest and most variable of all.

There is no narrowing either structurally or functionally at the cardia, the cardiac sphincter being situated from one to two inches above the anatomical cardia.

Distensibility.—The œsophagus has great powers of dilatation, and may attain a circumference of 30 cms., nevertheless it is an extremely delicate organ, and any sudden or injudicious stretching, as with an instrument, is very apt to rupture it.

Sphincters.—The upper orifice is formed by the lower fibres of the inferior constrictor muscle and belongs more to the pharynx than to the œsophagus. It is semilunar in shape, with the concavity directed forwards; the anterior lip is thin and is attached by a tendinous slip to the median groove on the cricoid cartilage. The posterior lip is formed by a thick band of striped muscle fibres

derived from the inferior constrictor; when these contract they draw the posterior lip against the cricoid cartilage and thus close the orifice.

For all practical purposes the crico-pharyngeal sphincter is not only the inferior sphincter of the pharynx—that is, it allows material to pass from the pharynx to the œsophagus—but is also the superior sphincter of the œsophagus, and throughout this book is referred to as such.

About one inch above the lower orifice the lumen of the œsophagus is closed by the cardiac sphincter, which is a specialized portion of the circular muscle fibres about one inch in length. (See Fig. 59, p. 72.)

These sphincters are normally in a state of tonic contraction.

Arrangement of the Muscle Fibres of the Œsophagus.—The arrangement of the muscle fibres of the œsophagus, especially at the upper end, and the manner in which they form a union between the pharynx and the œsophagus, are matters of considerable importance. This is especially so on account of the fact that the ordinary text-books and works of reference are very vague, and, for the most part, very inaccurate.

This region is of no small importance, inasmuch as it is the site of development of the hypopharyngeal diverticulum named after Zenker. In very few books is there to be found an accurate statement of facts bearing in mind the anatomy and physiology of the region and the pathology of this condition. It would therefore appear to be worth while to go into this matter in some detail in order that the anatomical structure of the part may be correlated with this important pathological condition, the pre-existing erroneous statements altered, and the whole question placed on a sound anatomical basis.

The most satisfactory anatomical description of this region is that given by Birmingham in 1898, which I have verified by several dissections, and to which I now freely refer.

“The outer or longitudinal muscular fibres form over the œsophagus generally, with the exception of its upper end, a well-developed continuous layer of longitudinal bundles, running parallel to one another, and in the direction of the tube. This layer, which is considerably thicker in general than the circular layer, will be distinctly displayed if the connective tissue which lies outside the muscular coat be carefully and completely removed from an œsophagus which has been moderately distended and still retains its connections with the larynx.

“On viewing the posterior aspect of such a preparation, it will be seen that the longitudinal fibres on this surface form a continuous layer until a point 1 to $1\frac{1}{4}$ inches below the cricoid is reached. Here the longitudinal fibres on the back of the tube divide into lateral halves, which gradually separate from each other and wind round to the side, leaving a V-shaped interval between the diverging masses above. As they pass round to the sides these fibres form two stout bands, the bundles of which run obliquely or somewhat spirally upwards and forwards. They ascend beneath the lower margin of the inferior constrictor, and, having been joined by the longitudinal fibres

of the side and front of the gullet, they wind round to the front, where meeting, they end below the middle of the back of the cricoid on a stout flat tendon, through the medium of which they are attached to the cricoid cartilage. This tendon, which is about $\frac{1}{4}$ inch in width above and somewhat wider below, runs up over the back of the cricoid, and having been joined by certain other fibres, which will be described below, it is finally attached to the upper end of the vertical ridge of the cricoid cartilage, near the point at which this ridge passes into the upper border of the quadrilateral plate.

“Whilst this is the usual termination of these two bands of longitudinal fibres in the majority of cases, still it will be occasionally found that some few of their superficial and posterior fibres are connected to the lower margin of the inferior constrictor (evidently by the intervention of connective tissue). In other cases a few of the superficial fibres form a small independent bundle, which is attached above to the lateral part of the inferior margin of the cricoid cartilage.

“As the ‘longitudinal bands’ described above pass forwards and upwards round the side of the œsophagus, their disposition is such that, on casual examination, one might easily fall into the error of thinking that they were connected to the lower margin of the inferior constrictor. A careful dissection, however, will show that this is not the case, and that while none, or at most, in some cases very few of their fibres are attached to the inferior constrictor, the bands pass on beneath the lower margin of this muscle to reach their common tendon on the front, as already described.

“The arrangement of the longitudinal fibres, as given above, will be better understood if, instead of tracing them from below upwards, we follow the more natural plan of tracing them from their origin above, downwards along the tube, thus: The longitudinal fibres of the œsophagus arise by a stout tendon— $\frac{1}{4}$ in. in width above, wider below—from the upper end of the vertical ridge on the back of the cricoid. This tendon, somewhat below the middle of the cricoid, gives rise to two stout muscular bands, which lie close together on the front of the tube at their origin, but diverge immediately below this, each passing round on the lateral aspect, and gradually spreading out in a dorsal direction, until finally, at a point about $1\frac{1}{4}$ inches below the cricoid, the fibres of opposite sides meet behind, and form, from this point downwards, all round the tube, a continuous layer of longitudinal fibres.

“If the front of the upper portion of the œsophagus be examined, the two ‘lateral bands’ will be seen winding round from the sides, and meeting higher up, before their common tendon is reached. Below this meeting the comparative fewness of the longitudinal fibres on this aspect near the middle line is noticeable for a few inches down; so few indeed are the fibres of the outer layer here, that the circular fibres are distinctly visible through their scant longitudinal covering.

“If we next turn our attention to the posterior aspect of the upper end of the tube, two questions will naturally arise: How is the V-shaped interval on the back between the diverging lateral bands filled? and, How exactly is the

muscular wall of the œsophagus connected posteriorly to that of the pharynx?

“As regards the first question, it may be briefly stated that the V-shaped interval, which measures nearly $1\frac{1}{4}$ inches from above downwards, is filled by the circular fibres of the œsophagus, covered over in its lower and greater portion by thin and scattered longitudinal fibres derived from the outer layer, and above for nearly $\frac{1}{2}$ inch by the lowest fibres of the inferior constrictor, which pass down for a short distance over the upper part of the œsophagus, overlapping and blending with its highest circular fibres.

“If the outer surface of the inferior constrictor be carefully dissected, it will be seen that this part is made up of two portions differently arranged—(a) an upper and much larger portion, consisting of all the fibres springing from the thyroid cartilage, and the upper and superficial portion of those arising from the cricoid; and (b) a lower part, consisting of the deeper fibres of the cricoid origin. The muscular bundles in the upper division are of a redder colour, and run obliquely upwards and towards the middle line, where they join the *raphé*—or, more correctly, decussate irregularly with those of the opposite side.

“The lower division of the inferior constrictor is paler in colour, and is made up of fibres which are more horizontal in direction, and which, unlike those of the upper division, *do not decussate or form a raphé*, but, on the contrary, run continuously from side to side in the form of annular (or, more correctly, C-shaped) bundles. This, which might be described as an œsophageal portion of the inferior constrictor, is apparently transitional between the constrictor and the circular fibres of the œsophagus, and is evidently specially modified in order to serve (somewhat after the fashion of the ‘adapter’ of a syringe) as the means of union between the muscular coats of the œsophagus and pharynx. It is narrow at each end, where it springs from the postero-lateral aspect of the cricoid below and under cover of (*i.e.* internal to) the cricoid origin of the main division of the constrictor. It is much wider—nearly $\frac{3}{4}$ inch—in the middle, being somewhat diamond-shaped, with the long axis horizontal. Above, it runs up into the interval between the lowest pair of decussating bundles of the constrictor; while inferiorly it passes down for over $\frac{1}{4}$ inch, filling the upper and wider part of the V-shaped interval between the two longitudinal bands, and here overlapping and blending with the highest circular fibres of this part of the œsophagus. Its lower margin is very distinct on the lateral aspect, where it is seen passing back from the cricoid across the recurrent nerve and the band of the longitudinal fibres. But posteriorly it is much less distinct; in fact, it is frequently difficult to make it out with certainty here. In this way the upper part of the V-shaped space is filled in.

“The lower portion of the V is occupied by the circular fibres of the œsophagus, covered by an extremely thin layer of somewhat pinnately arranged fibres, derived from the outer layer. If the two ‘longitudinal bands’ descending from their tendon of origin round the sides of the œsophagus be carefully examined, it will be seen that while the main mass of the two bands meet only

at a point about $1\frac{1}{4}$ inches below the cricoid, scattered fibres start off from their posterior margins at different levels, which wind round more rapidly to the back and meet (or decussate) in the middle line posteriorly. The highest of these fibres come off from the lateral bands near their upper ends, and pass back, forming very open V's, immediately below the 'œsophageal portion' of the inferior constrictor, while the succeeding fibres form more and more acute V's, until they finally fit into the angle between the two longitudinal bands, where these meet below. This arrangement will be made clearer on seeing a posterior view of the upper end of the œsophagus.

"Such is the arrangement of these fibres. It must, however, be under-

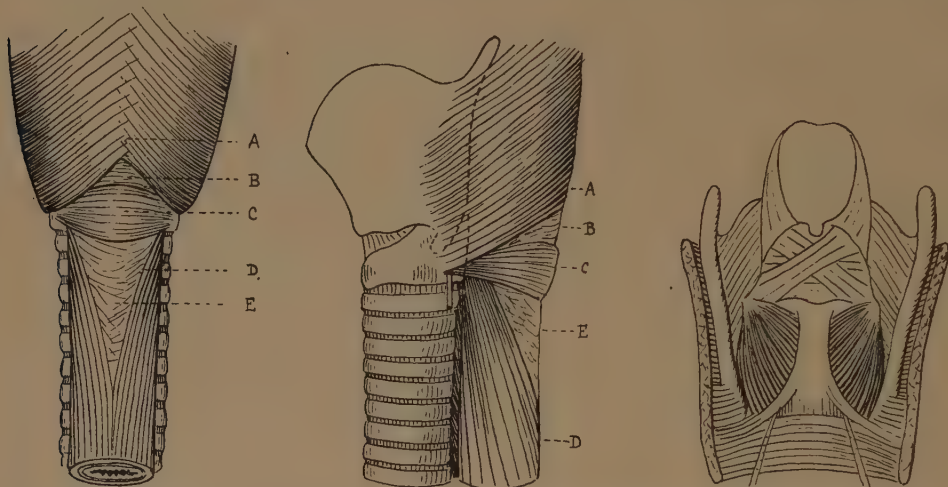


FIG. 1.—Diagrams of arrangement of muscular fibres at pharyngo-œsophageal junction.

A + B + C = Lower portion of inferior constrictor muscle.

A = Obliquely placed decussating fibres.

C = Horizontal fibres forming crico-pharyngeus muscle, or superior sphincter of the œsophagus.

B = Triangular space between these (exaggerated), which marks site of origin of a hypopharyngeal diverticulum.

D = Longitudinal fibres of the œsophagus.

E = Triangular space erroneously considered by some to be the site of origin of Zenker's diverticulum.

stood that they form an extremely thin and scant layer, but imperfectly hiding the circular fibres, which really fill up the V-shaped gap between the lateral bands.

"There still remains for us the second question—How exactly do the circular fibres end above?

"By dividing the larynx and trachea, and with them the anterior wall of the œsophagus, along the middle line, and then removing the mucous membrane and submucosa [from the posterior wall of the pharynx, etc.], it can be shown that the circular fibres at the back of the œsophagus pass into continuity

with the deeper fibres of the 'œsophageal portion' of the inferior constrictor; and it is difficult, on inspecting this part (posterior wall) alone, to tell where one ends and the other begins. On passing round to the lateral and anterior aspect, however, the highest circular fibres of the œsophagus can be easily determined; and, as pointed out above, they will be found joining the lateral margins of the common tendon. . . .

"It will sometimes, but not invariably, be found on making the above dissection that the highest and deepest circular fibres of the œsophagus on this aspect show a slight obliquity (the fibres sloping a little upwards as they approach the middle line), with a tendency to a faint decussation. On each side of the middle line the fibres, apparently after decussating, are connected with two thin flat muscular slips which arise, one on each side, about the level of the middle of the thyroid ala, from the elastic tissue of the submucosa (the pharyngeal aponeurosis), in which the palato-pharyngeus muscles end inferiorly. With these latter muscles the two little slips referred to (which constitute a pair of pharyngo-œsophageal muscles) are at least in functional continuity, and their use is apparently to fix the circular fibres of the œsophagus posteriorly.

"Two somewhat similar but much smaller slips are occasionally found passing downwards and backwards from the margin of the common tendon to the circular fibres. These two sets of slips are the only and very slight foundation which can be found for the third layer of muscular fibres described by some authors in the upper part of the gullet.

"If the highest circular fibres from the back round to the sides are followed, it will be found that they do not meet in front (this refers to the very highest bundles of this layer for a distance of only about $\frac{1}{16}$ of an inch from the termination of the layer). Instead of meeting in front, when they reach the antero-lateral aspect of the tube, they run up along the outer margin of the longitudinal bands, now come to the front, and join the outer edge of their common tendon, through which they—as well as the longitudinal fibres—are attached to the top of the vertical ridge of the cricoid." [Indeed, these upper fibres just referred to seem to form a transitional stage between the ordinary circular fibres of the œsophagus and the "œsophageal portion" of the inferior constrictor.]

"The fibres immediately beneath these just described meet in front, having previously crossed the posterior aspect of the end of the longitudinal bands, and thus form complete rings.

"Briefly, then, it may be said that the circular fibres of the œsophagus end as follows: Posteriorly, by becoming continuous with the corresponding fibres of the œsophageal portion of the inferior constrictor; on the lateral aspect, the highest fibres form a small bundle, which is united on each side to the margin of the common tendon of the longitudinal fibres, and thus to the cricoid; whilst anteriorly, they grow gradually thinner, and finally cease a little below the level of the junction of the longitudinal bands with their common tendon.

“ A very good demonstration of the two bands of the longitudinal fibres, of their meeting above on the anterior aspect of the tube, and of their connection with the tendon which attaches them to the cricoid, can be obtained by dividing the œsophagus 4 or 5 inches below the cricoid, clearing its anterior surface and separating it from the trachea, and, higher up, from the cricoid, the latter operation being facilitated by cutting the lowest fibres of the constrictor on each side. On first making this dissection, one is rather surprised to find that the œsophagus can be easily separated from the back of the cricoid, almost as far as its superior border, displaying fully the posterior crico-arytenoid muscles, while leaving the œsophagus intact. One is, perhaps, also surprised to find that the anterior wall of the tube is tendinous at its upper end, that is, opposite the back of the cricoid.

“ A more striking demonstration still is got by slitting up the posterior wall of the lower portion of the pharynx and upper part of the œsophagus, pinning out the sides, and removing the mucous membrane and submucosa, with the greatest care, from the anterior wall. The upper termination of the circular fibres and the ending of the longitudinal fibres on the tendinous band running up to the top of the cricoid are shown in a very distinct and interesting way.

“ In most specimens it will be found that a few slips of the longitudinal fibres are attached to the back of the trachea, and, higher up, to the connective tissue over the lower end of the ridge of the cricoid ” (Birmingham).

The V-shaped interval between the two diverging masses of longitudinal fibres referred to above has been called the “ triangle of Laimer ”, apparently misquoted by Mayo and others as Lannier’s triangle, or the “ Lannier-Hackermann area ”. This has been incorrectly stated by many writers to be the site of origin of a hypopharyngeal diverticulum.

The lower fibres of the inferior constrictor muscle referred to above, and clearly shown in Fig. 1, constitute what are known as the crico-pharyngeus muscle, or, to use an older term, the œsophageal portion of the inferior constrictor. It is this band of fibres which has been shown by Keith and others to be a true sphincter and to form the so-called upper opening or mouth of the œsophagus. More correctly this sphincter should be referred to, not as the upper sphincter of the œsophagus, but as the sphincter at the inferior extremity of the pharynx, on anatomical grounds. But, from the point of view of the physiology of deglutition and the manner in which a bolus is allowed to enter, or is prevented from entering, the œsophagus, it is both permissible and advisable to continue the use of the more practical term; for all purposes, therefore, when the upper opening, or mouth, or superior sphincter, of the œsophagus is mentioned, its position must be understood to be that of the transversely placed, non-decussating fibres of the lowest part of the inferior constrictor, that is, the crico-pharyngeus muscle. It is this muscle which is normally in a state of tonic contraction, and which is found to be in spasm in patients who have a hypopharyngeal diverticulum. Such a pouch, therefore, has its origin on the posterior wall of the junction of the pharynx and

œsophagus, above the crico-pharyngeus muscle, and below the more obliquely placed and decussating fibres of the remainder of the inferior constrictor muscle. In this position no circular fibres are found on the interior of the pharynx, and on the posterior and external aspect a minute triangular space is discernible when the fascia and connective tissue in this region have been carefully removed.

Further, I have found, on careful examination of several specimens, that the muscle fibres which form the superior boundary of the orifice of a Zenker's diverticulum are obviously the decussating fibres of the inferior constrictor exclusive of the crico-pharyngeus, whilst the fibres which lie below the orifice are the horizontally placed, non-decussating fibres of the crico-pharyngeus muscle.

Below this level the muscular coat consists of an outer longitudinal and an inner circular layer, which become continuous with the muscular coat of the stomach. The fibres in the upper third are striated, while the remainder are non-striated.

At about the level where the œsophagus passes through the diaphragm, the inner circular layer forms a specialized area—the lower or cardiac sphincter of the œsophagus (Keith). This is about one inch in length, and is situated from one to two inches above the junction of the œsophagus with the stomach—the anatomical cardia.

ANATOMICAL RELATIONS

1. Of the Cervical Portion.—Anteriorly lies the trachea, to the posterior membranous wall of which the œsophagus is intimately connected by cellular tissue and a few unstriated muscle fibres. In the groove between the œsophagus and the trachea the recurrent laryngeal nerve runs upwards to enter the pharynx by passing under cover of the inferior constrictor muscle.

Posteriorly, the œsophagus lies on the longus colli muscles and vertebral column, from which it is separated by the prevertebral fascia and a little loose cellular tissue.

Laterally, on the left side the recurrent laryngeal nerve runs along the left border before it gains the groove between the trachea and the œsophagus. Higher up this border is related to the inferior thyroid artery, the middle and inferior thyroid veins, the left lobe of the thyroid gland, and the thoracic duct.

The right border, owing to the deviation of the œsophagus to the left, is overlapped by the trachea and thus presents a less intimate relation to the corresponding structures on the right side.

More distant relations on both sides are the carotid sheath, the sympathetic chain, and the sterno-thyroid muscle, together with the sterno-hyoid and omohyoid muscles on a more superficial plane.

2. Of the Thoracic Portion.—For purposes of description this may be divided into two parts. At the level of the body of the fourth thoracic vertebra the œsophagus passes between two vascular arches, *i.e.* the arch of the aorta on the left, and the arch of the vena azygos on the right: the relations of the

œsophagus above and below this point differ considerably. It is therefore convenient to consider the two parts separately :

(a) *The upper portion, i.e.* above the level of the fourth thoracic vertebra. Anteriorly is the posterior membranous wall of the trachea ; posteriorly, the left longus colli muscle and prevertebral fascia. On the left side, the left

recurrent laryngeal nerve separates the œsophagus from the left common carotid artery. More remote relations are the origin of the left subclavian artery and the penultimate portion of the thoracic duct. On the right side, the right border is overlapped by the trachea, which separates it from the right recurrent nerve, the innominate artery, and the origin of the right subclavian and right common carotid arteries. Still more remote are the right vagus nerve, the innominate vein, and the superior vena cava.



FIG. 2.—Diagram showing anatomical relations of the œsophagus. (After Poirier.)

(b) *The Lower Portion.*—Anteriorly, at the level of the fourth thoracic vertebra the œsophagus is crossed obliquely by the ascending portion of the arch of the aorta ; at the level of the fifth it is crossed by the left bronchus, and immediately below this lies a group of lymphatic glands separating this portion of the œsophagus from the pericardium. Posteriorly, the œsophagus lies on the vertebral column as far as the body of the fifth thoracic vertebra ; it then passes forwards and to the left, and comes to lie upon the structures in the posterior mediastinum, namely, the

vena azygos, the thoracic duct, and the upper five right aortic intercostal vessels, and below this on the descending thoracic aorta.

If present, the common trunk of the bronchial arteries passes behind the œsophagus at the level of the fifth or sixth dorsal vertebra. Laterally, the visceral pleura covering the mediastinal surfaces of both lungs is related to the œsophagus throughout its thoracic course. On the left side it is separated

from it by the subclavian artery and the aorta for a short distance, and on the right side by the vena azygos.

The vagi form plexuses surrounding this portion of the œsophagus, specialized on its anterior and posterior aspects, and known respectively as the anterior and posterior œsophageal plexus, and collectively as the *Plexus Gulæ*.

3. Of the Diaphragmatic Portion.—The œsophageal orifice in the diaphragm is very oblique and looks forwards and to the left. Above, it is bounded by a few decussating fibres of the muscular part, or occasionally by the narrow posterior edge of the central tendon. At the sides and behind, the decussating bands from the two crura of the diaphragm are so arranged that they turn a flat surface towards the tube and thus form a canal for it, the largest wall of which is situated posteriorly and measures half an inch. The œsophagus is connected to the margins of the opening by areolar tissue. The vagi pass through this opening, the left anterior, and the right posterior, to the œsophagus.

4. Of the Abdominal Portion.—Anteriorly, the œsophagus is related to the left triangular ligament and below that to the posterior surface of the left lobe of the liver. Posteriorly, it rests on the left crus of the diaphragm and upon the angle which this makes with the aorta. The left border is in contact with the diaphragm, the base of the left triangular ligament, and the right border of the fundus of the stomach. The right border is related to the Spigelian lobe of the liver. The terminal portion is lodged in the œsophageal groove on the posterior surface of the left lobe of the liver. The right and left vagi are respectively posterior and anterior to this portion.

Fixation of the Œsophagus.—The œsophagus is maintained in position :

(a) *Above* : by its continuity with the pharynx and also by the attachment of its longitudinal fibres to the median ridge on the cricoid cartilage, as described above.

(b) *Below* : by its continuity with the stomach and by peritoneal folds which anchor it to the liver and diaphragm.

(c) *Throughout its length* : by bands of connective tissue which bind it to neighbouring organs, and also by numerous small slips of unstriated muscle which arise from its external surface and pass to the trachea, the bronchi, the aorta, and to the œsophageal opening in the diaphragm.

In spite of its numerous attachments the œsophagus may be readily displaced both in the vertical and lateral directions.

Arteries. (1) *In the Neck.*—Superior œsophageal arteries, which arise from the inferior thyroid artery.

(2) *In the Thorax.*—Middle œsophageal arteries, which arise

(a) Directly from the thoracic aorta.

(b) From the bronchial arteries.

(c) From the intercostal arteries.

(3) *In the Abdomen.*—Inferior œsophageal arteries, which arise

(a) From the left inferior phrenic artery.

(b) From the abdominal aorta.

(c) From the coronary, or left gastric, artery.

The arteries penetrate the walls of the œsophagus and form plexuses in the muscular, submucous, and mucous coats. From these networks arise capillaries which run in the papillæ and the glands.

Veins.—The venules which emerge from the capillary network referred to above form a venous plexus in the submucosa which is especially well marked in the lower part of the œsophagus. From this plexus the efferent branches penetrate the muscle-coat, being joined by veins from that layer, and form a second plexus on the surface of the œsophagus. From this plexus larger trunks arise which pass laterally at different levels to join the veins corresponding to the arteries which supply the different portions.

The veins from the abdominal portion run into the coronary vein, which is a tributary of the portal vein, thereby establishing a communication between the portal and systemic circulations.

Lymphatics.—The lymphatics form two plexuses, one in the submucous layer, which is continuous with that in the pharynx, the second between the muscle layers. The efferents from these are distributed in the following manner :

(1) *In the Cervical Portion.*—To the deep cervical lymph-glands beneath the sterno-mastoid muscle—especially to the paratracheal glands, which lie along the course of the recurrent laryngeal nerve. The efferent vessels from these glands join the jugular trunk, which runs into the thoracic duct on the left side, while on the right it ends in the junction of the internal jugular and subclavian veins.

(2) *In the Intrathoracic Portion.*—To the peri-œsophageal glands, which form part of the posterior mediastinal group. The majority of these lie on the anterior surface of the œsophagus, between it and the pericardium, whilst a few lie lateral to it in relation to the thoracic duct. Their efferents join the thoracic duct ; a few run to the tracheobronchial glands.

(3) *In the Abdomen.*—To the paracardial group of superior gastric lymph-glands, thence into the celiac group of pre-aortic glands.

Nerves.—The nerve supply is derived from two sources :

(1) Parasympathetic, through the vagus and recurrent laryngeal nerves.

(2) Sympathetic, through the cervical and thoracic portions of the sympathetic chain.

1. **THE PARASYMPATHETIC SUPPLY.** (a) *In the Neck.*—The œsophagus is supplied by the recurrent laryngeal branch of the vagus ; the origin and course of the nerve differs slightly on either side, as previously described. The left nerve arises from the left vagus where that nerve crosses the arch of the aorta. It passes below the arch and ascends to the side of the trachea. Its subsequent course is similar to that on the right side. Both nerves supply numerous branches to the œsophagus.

(b) *In the Thorax.*—The middle portion of the œsophagus receives numerous branches from the pulmonary plexuses on either side. After forming the pulmonary plexuses the two vagi converge towards the œsophagus, on the surface of which they break up and form the peri-œsophageal plexus. From

the distal extremity of this the two nerves are again differentiated and pass through the œsophageal opening in the diaphragm, the left anterior and the right posterior to the œsophagus.

Central Connections of the Vagus.—The motor fibres arise from the nucleus ambiguus, which also gives rise to the glossopharyngeal nerve and to the cerebral part of the spinal accessory nerve. This nucleus lies in the lateral part of the medulla oblongata, and is continuous with the anterior grey column of the spinal cord. The sensory fibres arise from the ganglia of the root and of the trunk, and end by arborizing round the cells of a nucleus which lies beneath the ala cinerea in the lower part of the fourth ventricle (rhomboid fossa). A few join the fasciculus solitarius. The vagus is connected through the ganglia of the trunk and the root with the facial, hypoglossal, glossopharyngeal, and spinal accessory nerves, and with the superior cervical ganglion of the sympathetic.

2. THE SYMPATHETIC SUPPLY. (a) *In the Neck.*—The œsophagus receives branches from :

(1) The superior cervical ganglion, and through this from the first to the fourth cervical nerves. In the majority of subjects the œsophageal branches arise, not from the ganglion itself, but from the nerves to the larynx.

(2) The inferior cervical ganglion, which is formed by rami communicantes from the seventh and eighth cervical nerves. A branch from this ganglion joins the recurrent laryngeal nerve.

The superior cervical ganglion sends branches to the glossopharyngeal, vagus, and hypoglossal nerves.

(b) *In the Thorax.*—Branches supply the œsophagus from :

(1) The upper four or five thoracic ganglia.

(2) The greater splanchnic nerve (fourth to seventh thoracic roots).

(3) The lesser splanchnic nerve (lower two or three thoracic roots).

(c) *In the Abdomen.*—The œsophagus receives several fine filaments from the solar plexus on either side.

An account of the distribution of the nerves to the œsophagus is given in the section on the minute structure (p. 14).

Surface Markings.—(1) *On the anterior surface of the body.* The upper extremity is at the level of the cricoid cartilage in the mid-line. The cardiac orifice can be indicated on the surface at a point on the seventh left costal cartilage half an inch from the left border of the xiphisternal junction. The œsophagus describes two curves to the left, as previously indicated (p. 2).

(2) *On the posterior surface of the body.* The œsophagus can be indicated by a line drawn from the spine of the sixth cervical vertebra to a point one inch to the left of the spine of the eleventh dorsal vertebra, the maximum deviation of the upper curve being opposite the third thoracic vertebra.

Minute Structure.—The œsophagus consists of five layers. From without inwards these are :

(1) The fibrous, areolar, or connective tissue coat.

(2) The outer longitudinal muscular layer.

- (3) The inner circular muscular layer.
- (4) The submucous layer.
- (5) The mucous membrane.

The external coat is a loose areolar covering separating the œsophagus from neighbouring structures, allowing it to distend, but not having the character of a well-marked fascial plane in that it limits the track of pus.

As previously described, the muscular coats in the upper third of the œsophagus are composed of striated muscle continuous with that of the pharynx; in the remainder of the organ they consist of plain muscle only.

The mucous membrane is lined by stratified epithelium, into which papillæ from the corium project. The corium is formed of areolar tissue; its external limit is marked by a layer of longitudinally disposed plain muscle fibres which constitute the *muscularis mucosæ*. This is separated from the muscle-coat by a layer of areolar tissue containing the larger branches of the blood-vessels and lymphatics and also the mucous glands.

The glands are of two types: (1) Mucous glands lying in the areolar layer, having large ducts which usually pass through a nodule of lymphoid tissue and open between the papillæ of the mucous membrane; these are found along the whole length of the œsophagus except the part immediately proximal to the cardiac sphincter. (2) Small tubulo-racemose glands, which are confined to the mucous membrane in the immediate neighbourhood of the cardiac sphincter; their ducts open upon the papillæ.

DISTRIBUTION OF THE NERVES TO THE ŒSOPHAGUS.—There are two ganglionated nerve-plexuses in the œsophagus:

(1) In the muscular coat, which corresponds to the plexus of Auerbach in the stomach.

(2) In the submucous coat, corresponding to the plexus of Meisner.

The œsophageal plexuses differ from those of the intestine in that they contain medullated nerve-fibres as well as non-medullated; the former are derived from the vagus and are distributed to the striped muscle; the non-medullated are distributed mainly to the plain muscle.

Before they reach their termination in the muscle the majority of medullated fibres traverse small ganglia which are situated in their course (Ranvier). The submucous plexus also possesses ganglia, though some workers (Koslowsky, 1900, quoted by Poirier) deny their existence.

EMBRYOLOGICAL CONSIDERATIONS

The Development of the Œsophagus.—The digestive tract arises from the dorsal portion of the yolk-sac by a process of constriction so that a tube, the archenteron, is formed, which is closed at either end and communicates with the yolk-sac by the narrow vitelline duct. By the infolding of the cephalic and caudal extremities of the embryo the archenteron becomes differentiated into three portions, termed the fore-, mid-, and hind-gut respectively.

From the primitive fore-gut the pharynx, œsophagus, and stomach are developed.

In the third week the œsophagus is a mere sphincter, or constriction, between the pharynx and the stomach. When the neck is differentiated during the second month the œsophagus undergoes a rapid elongation; the chief factor in producing this elongation is the development of the lungs and pleural cavities, whereby the stomach is pushed backwards into the body cavity.

Up to the third week the trachea and œsophagus form a single structure; the lung-buds have not yet appeared. There is, however, a histological differentiation of the two parts, which will be described later.

Separation of the œsophagus from the trachea takes place during the third and fourth weeks by the growth of two lateral septa which eventually meet and fuse in the mid-line to form a partition from which is differentiated the posterior (membranous) wall of the trachea and the anterior wall of the œsophagus. The last portion to fuse is the caudal extremity of the partition, *i.e.* at the level of the bifurcation of the trachea. (See Fig. 43, p. 51.)

In the fourth week the lung-buds arise from the distal extremity of the respiratory tube, and by their rapid increase in size cause the elongation of the œsophagus referred to above.

The œsophagus is of double origin, the upper part, with the trachea, being derived from the hinder part of the pharynx (the paratracheal part); the lower arises from the primitive alimentary canal (retrotracheal part).

Differentiation of the Histological Structure.—In a 4 mm. embryo the œsophagus is an epithelial tube, flattened from side to side, with a ventro-dorsal lumen. It is lined with two layers of cells, the nuclei nearest the lumen showing mitotic figures. The upper portion of the œsophagus shows a slightly different structure: here the dorsal portion of the tube is lined with a single row of cells, while the ventral portion shows three or four layers; this thickened portion is destined to form the respiratory tract.

The tube is surrounded by a mass of undifferentiated mesenchyme.

After the trachea and œsophagus have been separated by the fusion of the septa, the œsophageal lumen becomes greatly narrowed by a proliferation of the epithelial lining; some authorities consider that it becomes entirely obliterated (Kreuter, 1905); others maintain that the original lumen is never entirely lost (Forssner, 1907; Johnson, 1910).

In 20 mm. embryos vacuoles appear in the epithelium. There are two theories as to their origin:

- (1) That they are due to accumulation of intracellular fluid.
- (2) That they are due to an active moving apart of the cells, through a transference of mitotic activity from the inner to the outer layer of cells.

The latter is regarded as being the most probable explanation of their formation. The result is an enlargement of the lumen due to coalescence of neighbouring vacuoles.

At an early stage the epithelium of the œsophagus is thrown into longitudinal folds. In the upper part these are very complex; in the lower

two-thirds four primary folds are seen. The lumen at this stage is cruciform.

The epithelium of the œsophagus of embryos of 55 mms. contains areas of ciliated cells. In older embryos (187 mms.) a large area of the mucous membrane is covered with ciliated cells; this condition gradually gives way to the stratified epithelium seen in the adult, and at, or shortly after, birth, no cilia can be found.

The glands develop in two stages. The cardiac glands appear first, in embryos of 78 mms., in the lower 2-4 mms. of the tube; in 70 per cent of cases these glands are also found in the portion of the œsophagus above the eleventh tracheal ring (Schafer).

The deep (true) œsophageal glands are found throughout the length of the tube and develop later (240 mms. embryo). The circular layer of the muscle-coat is the first to be differentiated. It is seen in a 10 mm. embryo. The longitudinal layer develops later; it is clearly indicated in a 30 mm. embryo. The submucous layer is differentiated still later and first appears at the upper end of the tube.

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CHAPTER II

PHYSIOLOGICAL CONSIDERATIONS: BACTERIOLOGY

PHYSIOLOGICAL CONSIDERATIONS

THE œsophagus is a muscular tube along which food passes from the pharynx to the stomach. The part it plays in deglutition depends upon the consistency of the food swallowed.

1. **The Swallowing of Liquids.**—When a liquid is swallowed, an active voluntary contraction of the pharynx and associated muscles of the floor of the mouth forces the fluid downwards, and at the same time as this passes the posterior wall of the oral pharynx a stimulus is set up which relaxes the upper and lower sphincters of the œsophagus. Its further passage is due to the effect of gravity, and little or no active peristalsis of the œsophageal musculature occurs.

If, however, the fluid is of a very cold or very hot or caustic nature a second reflex is excited, and a spasm occurs either at the superior sphincter, or, more commonly, at the cardiac sphincter, of the canal.

In children, who drink more cautiously than adults, the reflex functions earlier in the act of swallowing and usually allows the mouth of the œsophagus to contract in time to prevent or hinder a dangerous material from entering the œsophagus.

In adults, on the other hand, fluid is commonly taken more quickly and in a draught rather than in mouthfuls, and any noxious fluid tends to pass into the lumen of the gullet before sufficient time has elapsed for any reflex action to come into play. In a similar fashion the fluid may pass into the stomach with scarcely any delay—in which case all corrosive effect is exerted on the gastric mucosa and the wall of the stomach generally. But frequently the cardiac sphincter passes into a state of spasm and the lower region of the œsophagus is considerably damaged.

These differences which occur in the actual act of swallowing fluids vary with the experience of the individual, and it is well known that heavy drinkers can literally pour fluid from a receptacle directly into the stomach, without any act of deglutition occurring. Thus the relaxation of the sphincters of the œsophagus is no longer an involuntary condition, but is now under the control of the will.

When a liquid is swallowed with the head at a lower level than the rest of the body, the fluid is taken and swallowed in mouthfuls only and cannot be "poured" down the œsophagus. It thus forms a "bolus" which has to be propelled by active peristalsis, and, under the circumstances, the laws governing the deglutition of solids are brought into play.

2. The Swallowing of Solids.—As a semi-solid or solid bolus of food passes through the pharynx it excites a reflex by contact with the posterior pharyngeal wall, which relaxes the superior sphincter, and the force of pharyngeal propulsion causes the bolus to pass the mouth of the œsophagus. This sphincter now closes and therefore prevents the active peristalsis of the œsophagus from forcing the bolus back again into the pharynx. Thus, once past this level, true involuntary swallowing commences. The journey through the upper third is performed rapidly on account of the force of the first voluntary effort, and also because striped muscle fibres are present for some distance down the œsophagus. The lower two-thirds are traversed slowly by means of the peristalsis of the unstriped muscle fibres. This becomes slower towards the cardiac sphincter, which relaxes by reflex inhibition only when the food reaches its immediate vicinity, and thus allows the bolus to enter the stomach. If, however, the bolus is not of the appropriate temperature or consistency, the inhibitory effect is not produced, and spasm occurs; therefore temporary, or even, occasionally, permanent arrest takes place.

Rhythmic regurgitation of stomach contents takes place through the cardiac sphincter into the lower part of the œsophagus, followed by a contraction of its walls which drives them back. This ceases as soon as the stomach contents become acid; it is termed the "acid control of the cardia", but should be termed "the acid control of the cardiac sphincter".

Investigation of the part played by the œsophagus in deglutition has been carried out by various methods—direct methods of inspection, palpation, and auscultation, by the insertion into the œsophagus of small balloons connected to a recording apparatus, and, more important still, by X-ray examination while swallowing an opaque bolus.

The minute structure of the œsophagus is correlated with its function in a remarkable way, as may be seen from a study of comparative anatomy. The tube is lined with stratified epithelium resembling that in other organs, *e.g.* the mouth and pharynx, which are exposed to friction. It is abundantly provided with mucous glands which secrete a lubricating fluid to facilitate the passage of food. The muscle-coat is arranged in two layers, longitudinal and circular, which arrangement is essential for the propagation of peristaltic movements.

Deglutition, therefore, is a reflex act, the centre for which is situated near the floor of the fourth ventricle above the respiratory centre. The afferent side of the reflex arc is formed by the second and third branches of the trigeminus and by the sensory fibres of the vagus. The centres for this reflex in the medulla are practically identical with the nuclei of the different cranial nerves which are concerned in the act. There is a close connection between the centre for deglutition and the respiratory and cardiac centres.

The propagation of the contraction waves along the œsophagus is determined by the intracentral nervous connections and does not depend upon the integrity of the muscle. The sympathetic is the constrictor and the vagus the dilator nerve to the œsophagus, and, as in the case of other muscular organs which exhibit peristalsis, reciprocal innervation of the sphincters is seen. If the nerves are divided the act of deglutition is abolished, the upper part of the tube is relaxed, while the lower part and the cardiac sphincter are in a state of tonic contraction.

Peristalsis of the œsophagus does not occur without a distinct act of deglutition. For example, if a bolus is placed into the œsophagus through an opening in the neck, no peristalsis occurs to move it onwards. It moves only if voluntary deglutition first takes place. On the other hand, a ligature passed round the œsophagus, or a complete section of it, does not stop the peristaltic wave. If a portion of the œsophagus is removed and this area replaced by a skin flap, no obstruction occurs, and solids are passed through this newly formed canal by the force of propulsion from above, and are then grasped by the musculature below and transmitted to the stomach. With fluids, of course, the passage is still more simple.

The observations on the sensory supply of the œsophagus have not yielded any clear results; some observers maintain that the sole sensory supply is derived from the vagus, and others that the sympathetic also contributes sensory fibres.

BACTERIOLOGY OF THE ŒSOPHAGUS

In the normal œsophagus a large number of micro-organisms are to be found. In part these are ingested with the food, but saliva and swallowed sputum charged with the organisms present in the upper air-passages, both normally and under abnormal conditions, and in diseases of the lungs and bronchi, form an important means of infection of the interior of the œsophagus. Under normal circumstances, however, as long as the mucous membrane remains intact, no ill-effects are produced by their presence. Under abnormal conditions the previously non-pathogenic micro-organisms become pathogenic; for example, in the acute specific fevers a catarrhal process may result from the causative organism producing a direct infection of the œsophageal wall. This may be further complicated by the addition of a secondary infection produced by the previously non-pathogenic organisms. Similarly, in any solution of the continuity of the œsophagus, as in chronic œsophagitis or trauma, or at the site of an operation wound, infection by this means invariably occurs.

The following bacteria are found almost constantly in the œsophagus of adults, namely, *bacillus subtilis*, *staphylococci* (albus, aureus, and citreus), *streptococci* and *pneumococci*, *micrococci catarrhalis* and *tetragenus*, *Friedländer's pneumobacillus*, *bacillus coli communis*, and *sarcinæ*.

It is important to note that certain of the more virulent organisms live only when teeth are present, and more especially when these are affected by caries.

Amongst them are found the bacillus fusiformis and Vincent's spirillum, streptococci, especially the streptococcus hæmolyticus, pneumococci, and certain anaerobic organisms. Other organisms may reach the buccal cavity accidentally and be transmitted to the œsophagus; amongst these are the Klebs-Löffler bacillus of diphtheria and the bacillus tuberculosis.

Œsophageal infection may be blood-borne, as in the eruptive fevers, syphilis, tuberculosis, and erysipelas.

In infection by laryngeal and pharyngeal diphtheria and in Vincent's angina, the infection of the œsophagus takes place by direct downward extension, and the specific organisms may be discovered in the pseudo-membrane formed in the œsophagus in these conditions.

SPECIAL PATHOLOGY AND MORBID HISTOLOGY

The pathology of œsophageal obstruction varies with the nature of the lesion producing the obstruction and with its cause, and will be considered in detail under the appropriate heading of each variety.

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CHAPTER III

GENERAL DIAGNOSIS

1. CLINICAL HISTORY

A most careful clinical history must be obtained from patients whose symptoms point to an obstruction of the œsophagus. There are three well-known and so-called cardinal symptoms in any case of chronic œsophageal obstruction, namely, dysphagia, discomfort in the chest related to swallowing, and regurgitation of food; the last is frequently described by the patient as vomiting. I wish to emphasize especially the early and insidious symptoms of a non-acute case.

The first symptom is not always dysphagia, and usually the patient notices for some weeks or months a sense of oppression or weight beneath the sternum. It is important to emphasize that actual pain is rarely present, and the sense of discomfort is due to the slight dilatation of the œsophagus resulting from the early narrowing of its lumen, together with colicky sensations of oppression due to increased muscular contractions of the organ. These sensations are usually noticed when swallowing is attempted, but may be present independently of deglutition. Then the patient finds that, in order to overcome the sense of fullness while eating, he has to take considerable draughts of fluid with his meals in order to wash the food into the stomach. At length there is a distinct obstruction to the passage of food.

Nevertheless, the most constant symptom of which the patient complains is that of dysphagia, and it is important to get him to give as accurate an account as possible of the exact time of the commencement of symptoms.

The next step is to ascertain the manner in which the difficulty commenced—whether suddenly or gradually. The progress of the symptoms since their onset is to be noted, and the patient asked whether the trouble remains the same over a considerable period of time, or whether it is getting better or worse; whether complete freedom from dysphagia occurs, and, if so, when this happens, and how long it is before further difficulty takes place.

Careful attention must be paid to any previous history, especially to that of any foreign body or corrosive fluid having been swallowed, or to a severe mental or emotional shock having occurred shortly before the onset of symptoms. This may or may not be mentioned by the patient spontaneously, but no harm is done by making enquiry.

The patient is asked to point to the position where the obstruction appears to be. The answer is merely of interest, but is of no importance, as it rarely indicates the level of the lesion.

The character of the obstruction, as to whether the site appears to be fixed or to move, or to vary from time to time, is sometimes of importance, some patients finding difficulty in swallowing solids, whilst in others the chief difficulty is in swallowing fluids.

Enquiry is now made as to whether the patient has been able to obtain any relief, either by the swallowing of large quantities of fluid or by adopting a particular attitude.

The question of pain or discomfort demands attention. Severe pain is rarely experienced in chronic œsophageal lesions, while a certain sense of discomfort or of fullness or pressure in the chest, usually immediately after swallowing, is very common, and, as has already been pointed out, this may be one of the premonitory symptoms of an early œsophageal lesion.

The patient is then interrogated concerning his general health and appetite; his normal weight, whether this is stationary or otherwise; and as to any previous complaints or illnesses.

It is, unfortunately, uncommon to see a case of obstruction due to a malignant growth in its earlier stages, and in fact the average duration of symptoms before a case comes to the surgeon is from six to eight months. This is for two reasons: first, because the patient does not pay attention to the earlier symptoms; and secondly, because the majority of medical men do not recognize the significance of these symptoms, or, if they do recognize them, do not know that life may be saved, or at any rate prolonged, by prompt surgical interference.

2. PHYSICAL EXAMINATION

A careful case-history having been taken, the clinician must now proceed to an examination of the patient. This should consist of

(a) A general examination.

(b) A local examination, with special reference to the œsophagus.

(a) GENERAL EXAMINATION. — The general examination must include especially the physical examination of the thorax by means of inspection, palpation, percussion, and auscultation in the ordinary way, comprising a careful investigation of the heart and great vessels, and of the lungs. This is performed in order to exclude, as far as possible, the presence of a thoracic aneurysm, and to ascertain whether the lungs are healthy or if there is any evidence of actual abnormality of the lungs or pleural cavities.

The abdomen and central nervous system are also carefully examined, and it is advisable to exclude the possibility of gout by examining the joints, etc., and also to ascertain that no glandular enlargement is present. A few moments suffice to conduct this portion of the examination, and attention is now directed to the œsophagus itself.

(b) **LOCAL EXAMINATION.**—**Inspection and palpation** are of value only when the lesion is confined to the cervical portion of the gullet, but in this situation a tumour may frequently be seen; if this is a pouch the patient may have noticed that it makes its appearance during or after eating, and if food is taken the clinician may see it gradually developing. If a tumour is present, its position, size, shape, consistency, and mobility are to be noted. Gentle pressure may cause a pouch to empty and its contents to be regurgitated.

Percussion may reveal a sonorous note if a dilated œsophagus or the upper portion of a pouch is distended with air, whilst a marked distension of the œsophagus may cause an area of dullness on either side of the vertebral column in a position where lung-resonance is usually found. This, together with the dullness produced by a large intrathoracic diverticulum, should have been noted in the general examination.

Auscultation of the œsophagus is rarely of value, and even if abnormalities are detected very erroneous conclusions are apt to be made. Two normal sounds usually occur: the first is due to the rapid passage of fluid into the lumen of the œsophagus; the second is said to occur some six seconds later, and to be due to the fluid reaching the cardia. As has previously been shown, the passage of fluid from the pharynx to the cardia in a normal person is almost instantaneous, and the second sound has been thought to result from a regurgitation of fluid or air from the stomach through the cardia and back again. As the method is of exaggerated importance and of no practical utility, further discussion is unnecessary.

Indirect Laryngoscopic Examination.—Indirect laryngoscopic examination by means of a mirror is easily performed in the general out-patient department or the private consulting-room, and it is used to exclude the presence of a lesion of the oral pharynx or hypopharynx or of the larynx. At the same time, the vocal cords are examined and effects of pressure on a recurrent laryngeal nerve may be seen.

Direct laryngoscopy is performed only in the operating-room. (See p. 28 *et seq.*)

X-ray Examination.—In a well-equipped general hospital X-ray examination may often be undertaken immediately the clinical examination has been completed, or a time should be arranged for the patient to attend when suitable arrangements have been made. This examination should be performed by the surgeon himself, using the fluorescent screen: he should never rely solely upon the report of the radiologist. The whole thorax must first be examined in order to exclude any other abnormality in this situation, and then a barium drink is given.

Technique.—The patient should fast for four or six hours before the radio-scopie examination is undertaken. If possible, any dilatation or diverticulum should have been emptied by a regurgitation.

A radio-opaque substance is previously prepared; the most generally suitable is a mixture of pure barium sulphate, which should be of creamy consistency.

R	Barii sulphatis	.	℥iii
	Lactis	.	℥i (or water + milk powder).

It may be flavoured with cocoa and sugar and thickened with arrow-root.

This is a pure, non-toxic and homogeneous material, which readily adapts itself to the interior of the œsophagus whatever abnormality be present. The consistency allows of a slow passage, similar to that of a well-masticated bolus of food. If the opaque drink is of the consistency of milk its passage is too rapid to be of real value. In the presence of any inflammatory or ulcerative lesion, bismuth subnitrate should be substituted for the barium, as the former has an antiseptic and more emollient action upon the œsophagus.

The position of the patient is very important. The œsophagus is seen to best advantage when the thorax is examined obliquely, and the patient must be moved so that the most advantageous position is obtained. This is found to be the right oblique position, *i.e.* with the right postero-lateral aspect of the patient's thorax towards the X-ray tube, and with the left antero-lateral aspect of the thorax against the fluorescent screen.

Occasionally a lateral examination is of value, whilst an antero-posterior view is almost useless on account of the density of the sternum, heart, and vertebral column.

When a mouthful of the opaque cream is swallowed its movement is carefully watched, and the direction, curves, and length of the œsophagus are demonstrated. In a normal person, once the bolus has passed the mouth of the canal its passage is regular, but occasionally a little delay is seen as the points of pressure are reached; this has been shown most satisfactorily by means of cinematography. The usual time occupied is six seconds, and by this method the actual peristaltic waves are most clearly seen. A few bubbles of air are usually noted with the barium cream.

If any obstruction is present the first point to determine is the site at which this occurs. Careful observation is made in order that the calibre of the œsophagus at the level of the stricture is estimated. The size of the lumen above the stricture is easily seen, but one or more subsequent mouthfuls may be necessary fully to distend this. The movements of the œsophageal wall above the stenosis are watched, and when a sufficient quantity of the opaque cream has been brought to a standstill its shape is accurately determined. Inspection is continued in order to ascertain the manner in which the lower part of the canal fills: this may take place from the top or from the bottom of the opacity.

Below the level of the obstruction very little can be learned, as the substance which passes into this portion of the canal is rapidly transmitted to the stomach. It is sometimes very important to know the site of the lower level of a stricture, so that the total length of the stricture may be accurately determined. For this purpose retrograde radiography is employed. This may be performed by placing the patient either in the right lateral position, or, better still, in Trendelenburg's position, either by supporting the pelvis upon a number of pillows or by raising the foot of the radioscopic couch. The radiogram is taken in this position, while the patient is in the act of

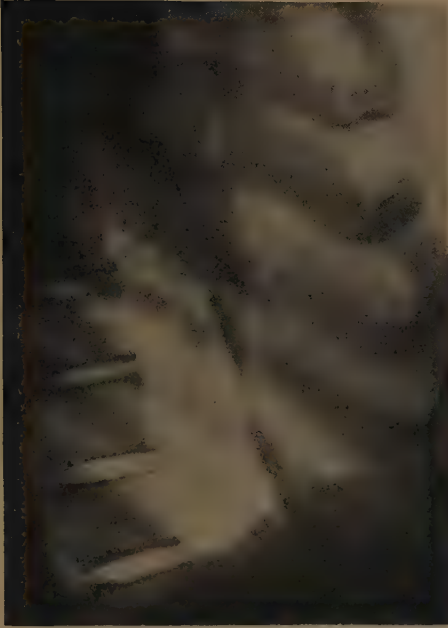


FIG. 3.—Radiogram of case of carcinoma of middle third of œsophagus. The radiogram of the same case taken in Trendelenburg's position is shown in Fig. 4.



FIG. 4.—Radiogram of case of carcinoma of œsophagus taken in Trendelenburg's position after a radio-opaque drink and with a barium emulsion passed through a gastrostomy.

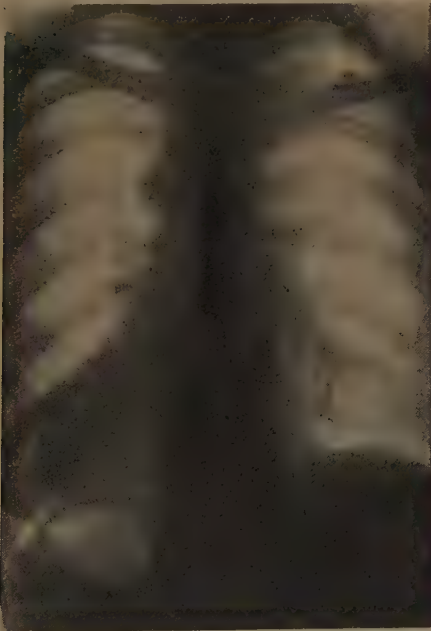


FIG. 5.—Cancer of the œsophagus. The radiogram was taken in the antero-posterior plane and shows the poor definition of the œsophagus on account of the opacity of the mediastinum.

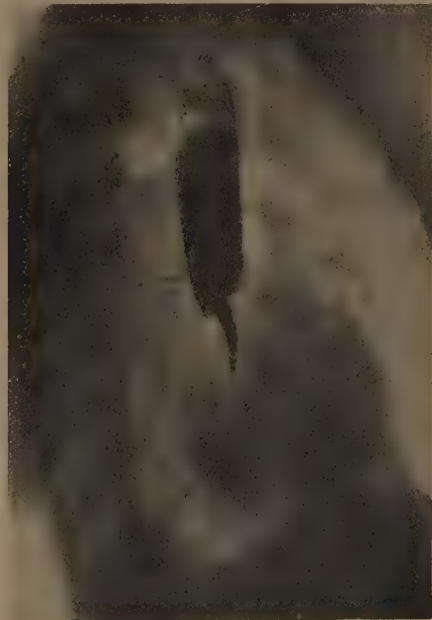


FIG. 6.—Cancer of the œsophagus. The picture shows the clear outline of the shadow made by the opaque drink when the radiogram is taken obliquely through the thorax.

swallowing a fairly copious draught of radio-opaque material, which now fills the œsophagus below the level of the stenosis.

If a gastrostomy has previously been performed, an opaque cream may be placed in the stomach, and examination in Trendelenburg's position shows a regurgitation of this substance at the moment of swallowing. It has been suggested that a hollow sound should be passed beyond the obstruction with the patient in this position, and the lower portion of the œsophagus filled with barium by this means. This is not without danger, and is rarely, if ever, necessary.

Even when no stenosis is present X-ray examination is of value, as it may

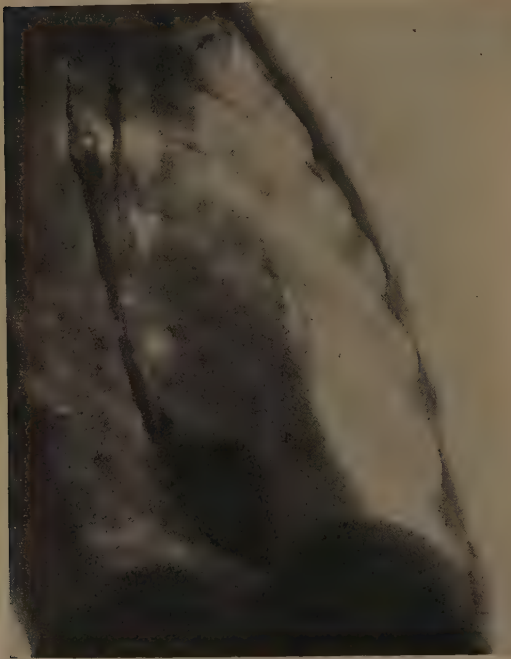


FIG. 7.—Radiogram of a case of cardiospasm, showing regular outline of œsophagus.

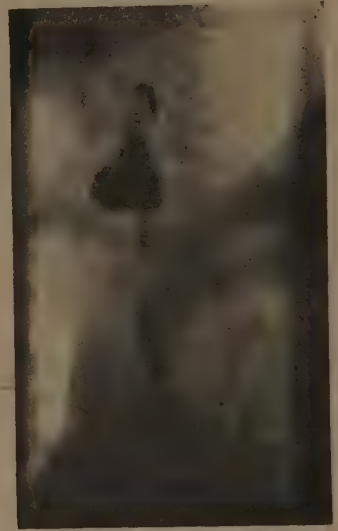


FIG. 8.—Radiogram in the oblique position of a case of hypopharyngeal diverticulum. *Note.*—This is quite indeterminate unless taken in conjunction with Fig. 9.

show the retention of a small portion of the opaque substance at the site of an early lesion, similar to the shadow sometimes left behind at the site of a gastric ulcer after the main gastric meal has passed on. It is most typically observed in a carcinomatous ulcer developing in a previously dilated œsophagus. If only a slight stenosis is present no arrest of the fluid is seen, but a slight diminution in calibre of the tube may be indicated. This frequently calls for a repetition of the examination, or at least indicates the region of the œsophagus to which special attention is to be paid on œsophagoscopy. Even if the exact nature of the cause of the obstruction is not typical enough to allow of an absolute diagnosis, the site of the stenosis is located, and endoscopic examination is rendered easier.

Instead of cream, an opaque pellet may be used, but this tends to act as a foreign body, is far more irritating to the patient, gives only an uncertain idea of the level of the lesion, and shows none of the details which were noted by means of the cream. It is very doubtful if its use is ever necessary.

Other methods of examination by means of X-rays have been devised, but are rarely utilized. A sound is sometimes used, for example in the examination of what appears to be a diverticulum, when the lumen of the œsophagus cannot be differentiated otherwise from the opaque material filling the pouch. Soft rubber sounds may be passed as far as the cardia and then distended with an opaque substance, such as mercury, lead shot, or a thick barium drink. The general examination of the œsophagus by means of sounds is described later, but their use on the whole is deprecated.

When the radioscopic examination has been concluded to the examiner's satisfaction it is usually advisable to take a radiogram in order that a permanent record may be kept. Fig. 3 shows the appearance of a malignant stricture at the level of the left bronchus. Fig. 4 shows the same case taken in Trendelenburg's position after barium had been passed into the stomach at the same time as barium cream was swallowed.

In the accompanying radiograms the typical appearances of certain forms of œsophageal obstruction are shown. In Figs. 5 and 6 is seen the typical picture of barium passing through a malignant stricture, with the irregularity of its lower extremity (rat-tail-like appearance). Fig. 7 shows the smooth regular outline seen in a case of cardiospasm. In a third case, the one picture (Fig. 8) shows a stricture with the barium appearing to pass from the lower end of the dilated area; but when this patient was rotated and examined in the antero-posterior plane (Fig. 9), the barium could be seen emerging from the upper end of the dilatation, giving the typical radioscopic appearance of a Zenker's diverticulum.



FIG. 9.—Radiogram of the same case as Fig. 8 taken in the antero-posterior position, showing stream of opaque solution passing through the upper end of the dilatation.

DIRECT LARYNGOSCOPY, BRONCHOSCOPY, ŒSOPHAGOSCOPY, AND GASTROSCOPY

A very great deal might be written about these methods of investigation, but an attempt will be made to give succinctly a description of the modern instruments, indications and contra-indications, and technique.

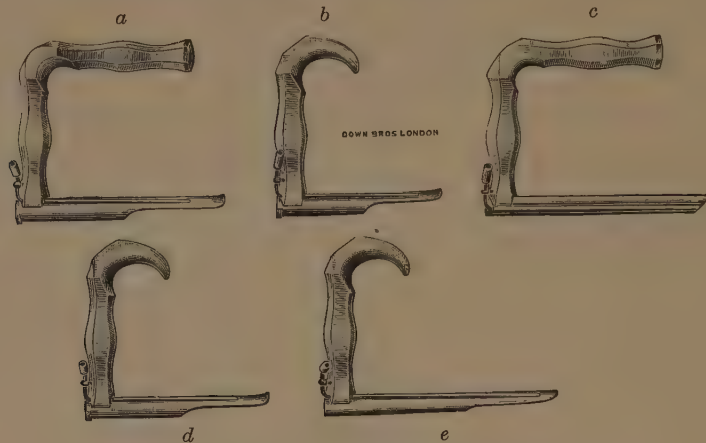


FIG. 10.—Laryngoscopes.

- a. Adult's laryngoscope, with removable slide and heavy handle, for introduction of bronchoscopes and for operating in larynx ; size 14 mms. $\times$ 16 cms.
- b. Children's laryngoscope, with removable slide and short handle ; size 12 mms. $\times$ 14 cms.
- c. Anterior commissure laryngoscope, with heart-shaped opening, used at side of tongue and not over dorsum ; useful as an œsophageal speculum for children and young women ; size 10 mms. $\times$ 17 cms.
- d. Children's œsophageal speculum, with short handle ; size 13 mms. $\times$ 17.5 cms.
- e. Adult's œsophageal speculum, with short handle ; size 15 mms. $\times$ 24.5 cms.

It must clearly be understood that the routine examination of the patient has first been conducted ; if possible, a radioscopic examination should also have been made.

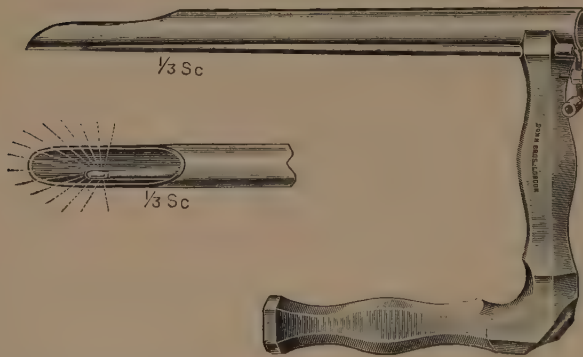


FIG. 11.—Adult's œsophageal speculum, with long handle and extra length of tube ; may also be used as a laryngoscope.

INSTRUMENTARIUM.
Laryngoscopes. — Modern laryngoscopes are illustrated in Figs. 10, 11. One side of the instrument consists of a movable slide, which allows the removal of the laryngoscope after a bronchoscope or œsophagoscope has been inserted through it. A laryngo-

scope may also be used as a cervical œsophageal speculum.

Bronchoscopes. (See Fig. 12 *a, b, c, d, e.*)—Not only must the œsophagoscopist be able to examine the food-passages, but he is frequently called upon to

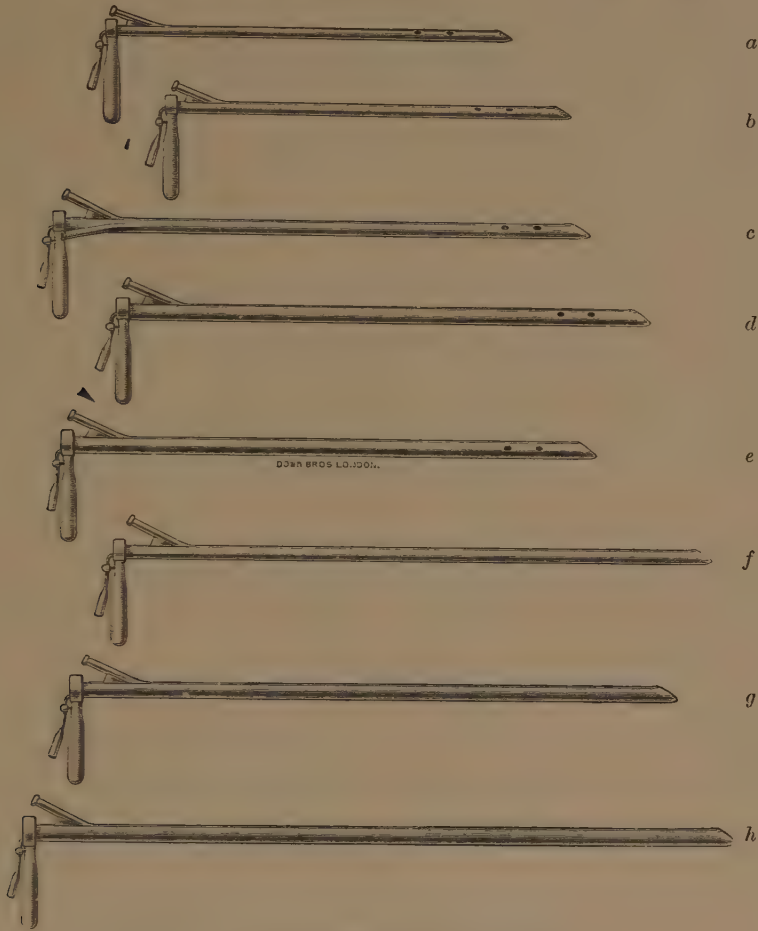


FIG. 12.—Bronchoscopes and œsophagoscopes.

- a.* Infant's bronchoscope ; size 4 mms. $\times$ 30 cms.
- b.* Children's bronchoscope ; size 5 mms. $\times$ 30 cms.
- c.* Adult's aspirating bronchoscope, for cases with abundant secretion and for drainage of pulmonary abscesses ; size 7 mms. $\times$ 40 cms.
- d.* Adolescent's bronchoscope ; also for the deeper bronchi of adults ; size 7 mms. $\times$ 40 cms.
- e.* Adult's bronchoscope ; size 9 mms. $\times$ 40 cms.
- f.* Children's œsophagoscope ; size 7 mms. $\times$ 45 cms.
- g.* Adult's œsophagoscope ; size 9 mms. $\times$ 45 cms.
- h.* Gastroscope ; size 10 mms. $\times$ 53 cms.

fulfil the rôle of a bronchoscopist, and although bronchoscopy does not, strictly, come within the scope of this work, a little attention must be paid to it.

A bronchoscopy is often necessary, even in purely œsophageal work, for determining the freedom or involvement of the trachea or bronchi in lesions of

the œsophagus, for example carcinoma ; also for the determination and treatment of complications of œsophageal or peri-œsophageal conditions. Jackson uses the following five sizes of standard bronchoscopes :

Infant's	4 mms. by 30 cms.
Child's	5 mms. by 30 cms.
Adolescent's	7 mms. by 40 cms.
Adult's	9 mms. by 40 cms.
Special	5 mms. by 45 cms.

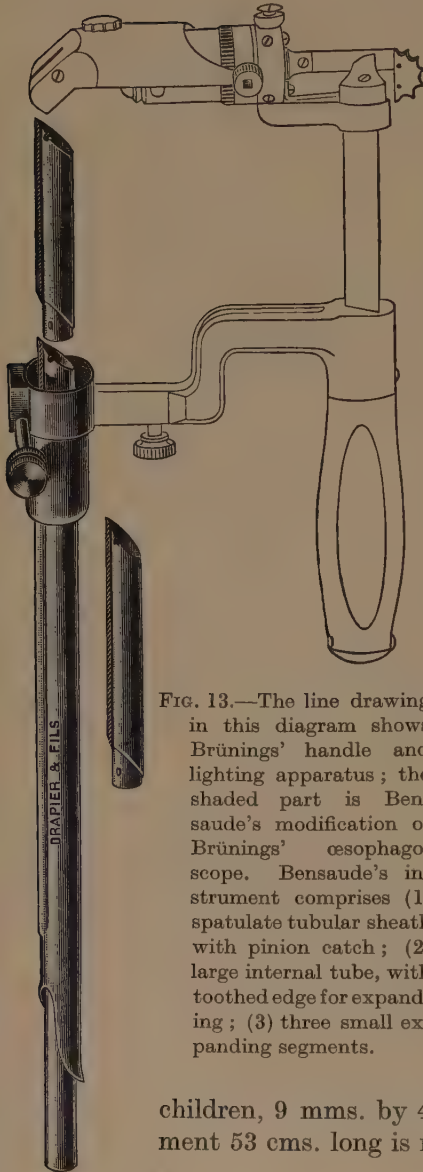


FIG. 13.—The line drawing in this diagram shows Brünings' handle and lighting apparatus; the shaded part is Bensaude's modification of Brünings' œsophagoscope. Bensaude's instrument comprises (1) spatulate tubular sheath with pinion catch; (2) large internal tube, with toothed edge for expanding; (3) three small expanding segments.

The construction of bronchoscopes and œsophagoscopes is so similar that they will be described together under the next heading.

Œsophagoscopes. (See Figs. 12 *f, g, h, 13, 14, 15,* and 57.)—An œsophagoscope or bronchoscope is a straight, rigid, hollow tube, open at each end; the proximal end is at right angles to its long axis; the distal end is either spatulate or bevelled in order to allow of ease in introduction. In cross-section it may be circular or oval.

A bronchoscope has conveniently-placed lateral breathing holes near its distal end (Fig. 12), while an œsophagoscope has no fenestræ.

For occasional use a window may be attached to the proximal end in order that the œsophagus may be distended with air.

I have three types of œsophagoscope in constant use :

- (1) Jackson's œsophagoscope.
- (2) Bensaude's modification of Brünings' œsophagoscope.
- (3) My own modification of Mosher's œsophagoscope.

(1) *Jackson's Œsophagoscope.*—Jackson's œsophagoscope has a small separate canal in its upper border, which carries a light-holder, and a separate canal along its lower border as an aspirator. Its distal end is bevelled. It is made in two standard sizes : 7 mms. by 45 cms. for children, 9 mms. by 45 cms. for adults. Occasionally an instrument 53 cms. long is needed for adults (Fig. 12 *h*).

(2) In order that the examiner may have good visibility by being as near to the lesion as possible, Brünings designed a double tube. His œsophagoscope consists of a comparatively short external tube into which is passed an internal tube, which, by means of a spring, can be lowered until it reaches the required level. Thus for each patient an œsophagoscope is obtained of exactly the right length. The spring arrangement being somewhat difficult to manage, Bensaude has modified the inner tube so that it works by a toothed ratchet (Figs. 13 and 14).

The outer tube has a spatulate end, and is 24 cms. long.

The inner tube is multiple and consists of three segments, one a little longer than the outer tube and the other two equal to half the length of the long inner tube, each 9 cms. long. The three tubes may be joined together by means of a nipple. The screw working the toothed ratchet on each allows progress to be made with the utmost gentleness, and the exact point of the lesion is easily reached. The full length of the instrument is 44 cms. In cross-section it is circular, its outer diameter being 11 mms. and its inner diameter being 9 mms. On the outside it is calibrated in centimetres.

The spatulate end obviates the need for any obturator, and once the inner tube is inserted the distal end is at right angles to the long axis of the tube, and therefore the lumen is seen to better advantage than with an instrument with a bevelled end.

Without the inner tube the instrument makes a good cervical œsophageal speculum.

The illumination is provided for this instrument by means of Brünings' handle (Figs. 13 and 16), and a separate aspirator has to be introduced through its lumen.

(3) Mosher's œsophagoscope is oval in cross-section, and of a much larger size than the other two. It measures 17 by 15 mms., and is made in three lengths, 21, 30, and 44 cms. It

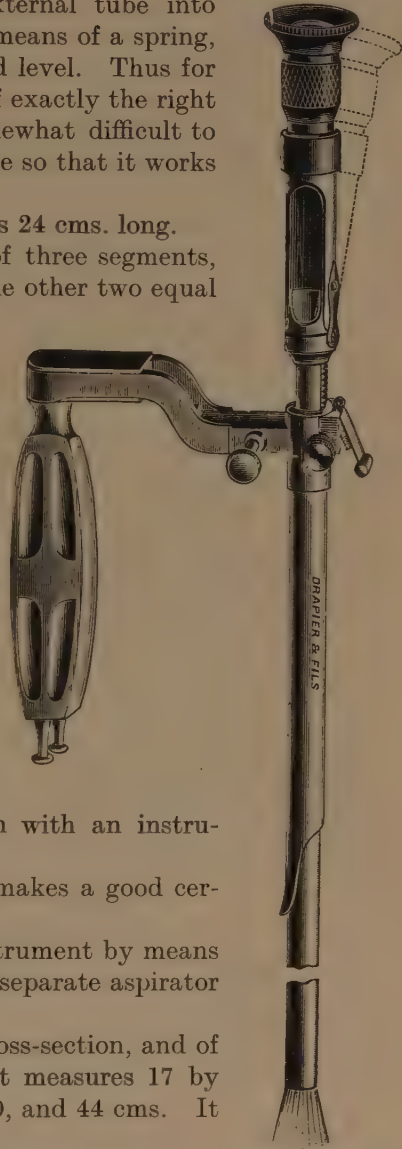


FIG. 14.—Bensaude's light-carrying œsophagoscope consists of (1) an initial tube in the form of Brünings' tube. It is fitted with a cross handle affording a firm grip, which receives the conducting wire of the current; (2) a propelled tube containing the light which lights automatically the moment this tube passes beyond the initial tube. It is also fitted with a toothed propelling edge which works into a microscopic pinion fixed on to the initial tube and is instantly immovable; (3) two interchangeable segments of tube fitted in the same way, and allowing of very gentle propulsion; (4) an optical system which can be regulated so as to enlarge the field at any distance and to examine objects invisible to the naked eye.

has been modified by Howarth, who has placed a canal in its wall for a light-carrier, and I have modified it further by placing another canal opposite the light-carrier for purposes of aspiration. It is made with an attachment to fit Brünings' handle, and may therefore be used with either proximal or distal illumination. (See instrument illustrated at top of Fig. 15.)

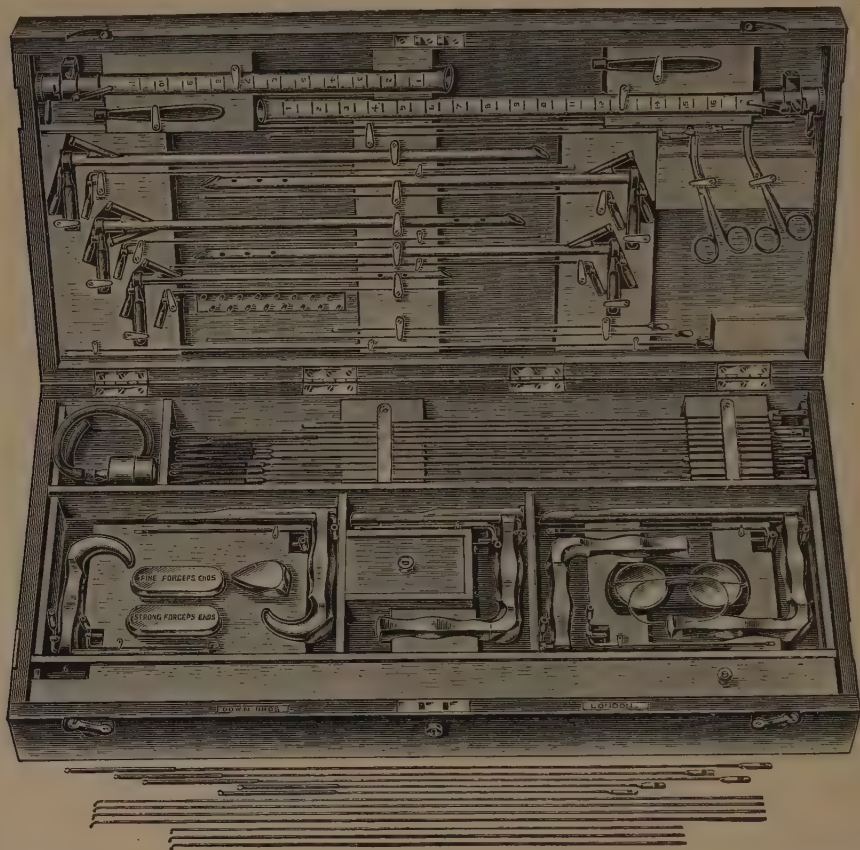


FIG. 15.—Down Bros.' broncho-oesophagoscopic set in case. Contents: 3 laryngoscopic and 2 œsophageal specula, 4 bronchoscopes, 3 œsophagoscopes, bite block, 2 forceps handles with set of 4 tubes and stilettes and 13 ends, 6 various foreign body hooks, 6 bougies and 3 each long and short swab holders, 3 aspirator tubes, bellows, spectacles, 12 spare lamps, 4 sets cords.

An obturator or mandrin is not only unnecessary but inadvisable. If one is used a foreign body may be overridden, or a pouch or diseased œsophagus—or even a normal œsophagus—perforated. No endoscope should ever be introduced into an air- or food-passage except under the control of the vision.

Lighting Apparatus.—Illumination may be provided by a small lamp placed at the end of the tube, by a light situated in the handle of the instrument and reflected into it by means of a mirror, or by reflection from a mirror

reflector attached to the examiner's forehead. I much prefer the first two methods.

Œsophagoscopes designed with the light at the distal end have a small separate canal in the upper wall of the tube, with a long carrier holding the light. The advantages of these are that the lamp can be withdrawn and, if necessary, renewed or cleaned during an endoscopic examination without removal of the tube, and in addition a good illumination of the field is obtained.

If the light is carried in the handle, as in Brünings' instrument, a reflector is necessary, which is apt to get in the way of the passage of instruments, though with a little practice this is soon avoided. The same advantages as before with regard to cleaning or renewing the light hold good, and the additional advantages are that even when the lumen of the œsophagus becomes filled with secretions or blood the light is never obscured, and the one handle and light may be used for all bronchoscopes and œsophagoscopes which have an adjustment to fit the Brünings' handle.

A forehead mirror reflector has similar advantages, but its great disadvantage is that the light has to be refocussed each time the operator moves his head, and it is not recommended.

Battery.—The electric current should not be obtained from the main, but from a battery which is fully described beneath Fig. 17.

Aspirators.—Even if an aspirating canal is present in the œsophagoscope used, separate aspirating tubes may be necessary, and are of larger calibre. Aspiration is provided either by means

of an endo-pump, which is easily portable and may be used anywhere, and which gives both positive and negative pressures, or by means of Lake's

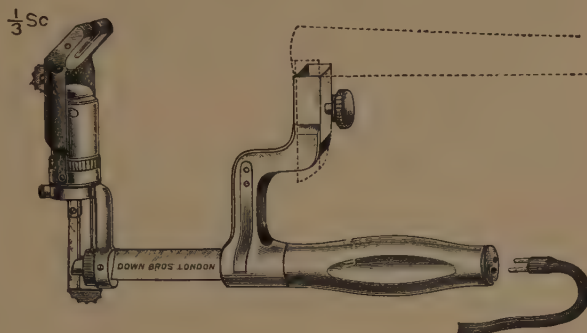


FIG. 16.—Brünings' handle (with stainless steel mirror).



FIG. 17.—Triple battery, with six extra-large dry cells and three sets of terminals, so that two illuminated instruments and a spare lamp can be used at the same time. Owing to improvements in design, new dry cells can easily be placed in position when required.

suction apparatus, worked off an oxygen, nitrous oxide, or air cylinder, or by means of an electric pump (Figs. 18, 19, 20, 21).

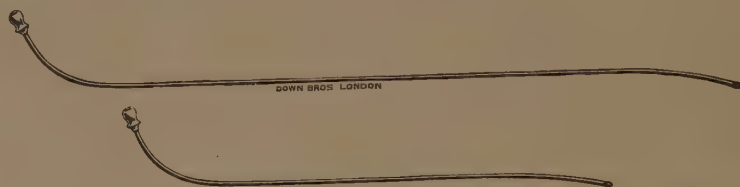


FIG. 18.—Two aspirating cannulae.



FIG. 19.—Jackson's aspirating tube (made in lengths of 36, 45, and 60 cms.).

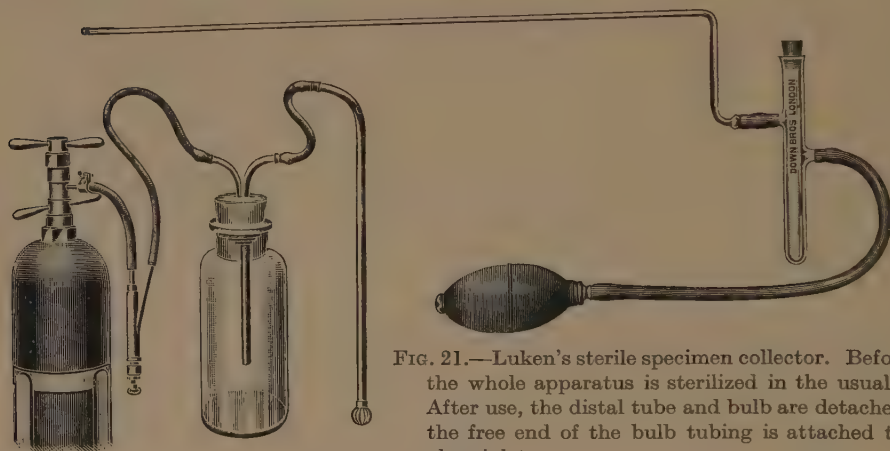


FIG. 20.—The illustration shows the Lake's suction-pump as attached to the gas cylinder, together with collecting bottle and sucker. (Genito-Urinary Mfg. Co., London.)

FIG. 21.—Luken's sterile specimen collector. Before use the whole apparatus is sterilized in the usual way. After use, the distal tube and bulb are detached and the free end of the bulb tubing is attached to the glass inlet.

Forceps.—Two types of forceps are commonly used in œsophageal work : (1) The crocodile or alligator pattern (Figs. 22, 23). In this type of forceps there are two blades. The lower blade is fixed either flat or tilted up. The upper blade is movable. Different types of blades are used for grasping, pinching, or cutting (Fig. 22). Special heavy patterns of cutting-shears (Fig. 23) are made for tough foreign bodies.

(2) Forceps with spring-spread jaws, over which passes an outer tube which causes the jaws to approximate. A variety of these are shown in Figs. 24 to 29, together with special foreign-body instruments for removing tacks, staples, safety-pins, etc.

Sounds, Bougies, Dilators, etc.—These are illustrated in Figs. 30 to 37, and are described beneath the illustration.

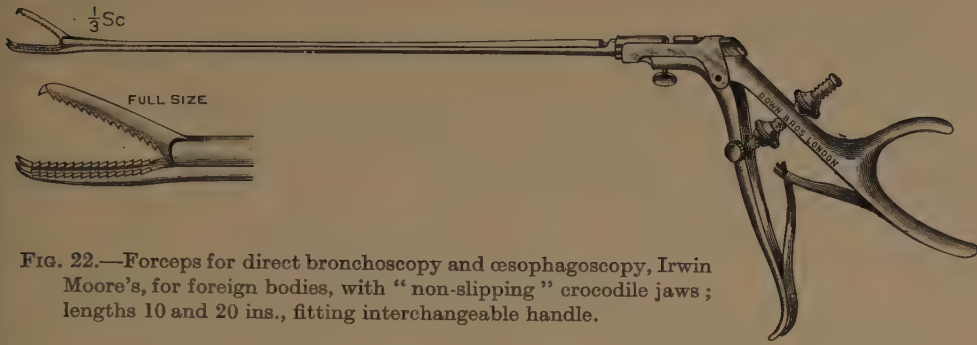


FIG. 22.—Forceps for direct bronchoscopy and oesophagoscopy, Irwin Moore's, for foreign bodies, with "non-slipping" crocodile jaws; lengths 10 and 20 ins., fitting interchangeable handle.

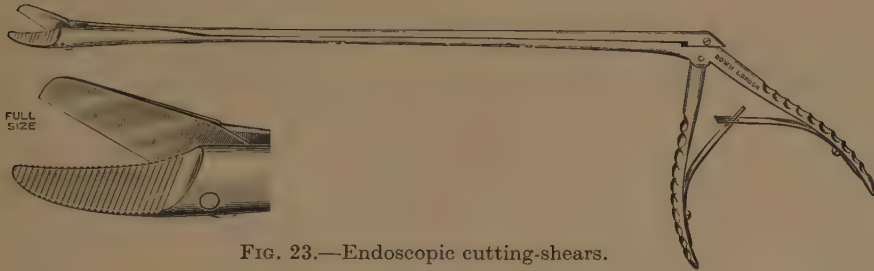


FIG. 23.—Endoscopic cutting-shears.

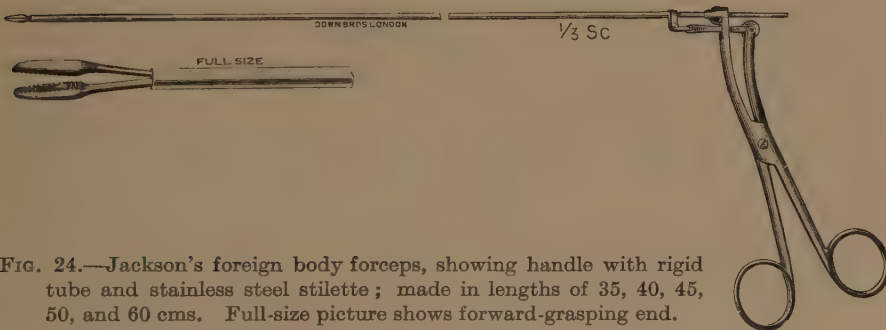


FIG. 24.—Jackson's foreign body forceps, showing handle with rigid tube and stainless steel stilette; made in lengths of 35, 40, 45, 50, and 60 cms. Full-size picture shows forward-grasping end.

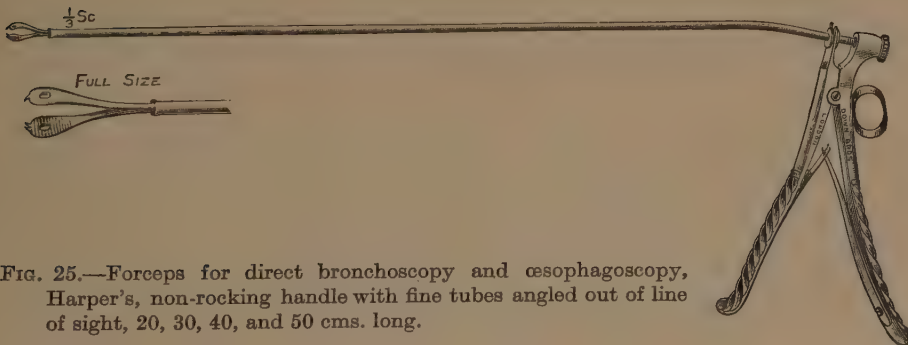


FIG. 25.—Forceps for direct bronchoscopy and oesophagoscopy, Harper's, non-rocking handle with fine tubes angled out of line of sight, 20, 30, 40, and 50 cms. long.

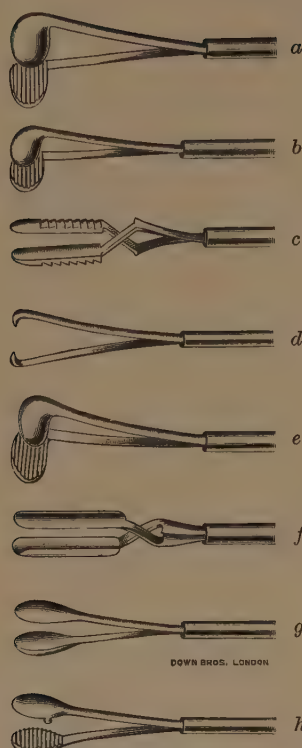


FIG. 26.

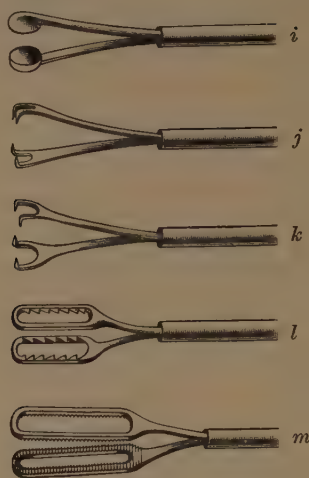


FIG. 27.

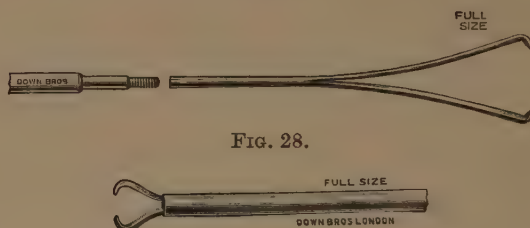


FIG. 28.



FIG. 29.

FIG. 26.—This figure shows Jackson's special bronchoscopic and œsophagoscopic forceps ends.

Each forceps should have its own handle mechanism, an example of which is shown in Fig. 24. These forceps give delicacy of touch and great security of grasp, and are therefore ideally suited for the gentle, careful work which is required of them. They are made in three weights, delicate, medium, and heavy.

a and *b*. Side-curved forceps. These are most generally used for all ordinary purposes.

c. Expanding forceps, for holding hollow objects by the inside.

d. Jackson's rotation forceps, used for turning an irregular foreign body in order to render position safer for withdrawal, *e.g.* for the removal of safety-pins by version and withdrawal.

e. Bronchial side-grasping forceps.

f. Cross-action forceps, similar to *c*, but non-corrugated.

g. Grasping forceps, with a very stiff, expanding spring. The cupped facets increase the security of grasp upon a convex object. The stiff, expanding spring makes them also suitable for dilatation of a bronchus.

h. Tucker's tack and pin forceps, with single lip.

FIG. 27.—Brünings' forceps ends.

These forceps ends are made to fit Jackson's standard handle, and those shown are :

i. Bronchial cutting-scoop, which is useful in œsophageal work, *e.g.* for removing portions of tissue for biopsy from the œsophagus.

j. Bronchial claw forceps with $\frac{3}{4}$ teeth.

k. Heavier pattern, as *j*, for œsophageal work.

l and *m*. Brünings' bronchial and œsophageal fenestrated and serrated forceps.

FIG. 28.—Jackson's rotation forceps (as in Fig. 26 *d*), showing thumb nut on the end of the stilette, which prevents it being pulled out. The cannula adjusts the closure and the extent of expansion.

FIG. 29.—Coolidge's swab-carrier.



FIG. 30.—Jackson's hook, with obtuse angle, 45 and 60 cms. long.



FIG. 31.—Jackson's hook, rectangular, 45 and 60 cms. long.

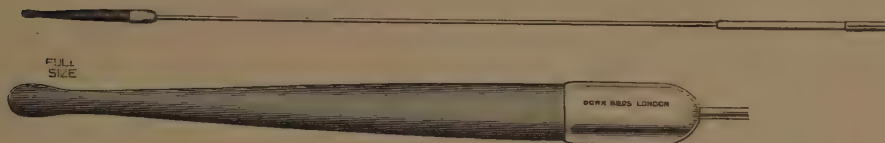


FIG. 32.—Oesophageal bougie (Jackson's pattern).



FIG. 33.—Gum-elastic oesophageal bougie.



FIG. 34.—Gum-elastic oesophageal catheter, which is used for washing out the oesophagus, and also for treating a carcinoma by the intra-oesophageal application of Radium. See p. 193.

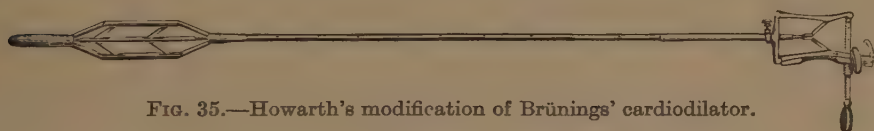


FIG. 35.—Howarth's modification of Brünings' cardiodilator.

Spectacles.—In order that the operator's eyes may be protected it is advisable for him to wear a large-sized pair of plain glass spectacles when performing endoscopic examinations.

Indications.—In skilled hands oesophagoscopy is almost devoid of danger, and with a careful technique and tactful handling of the patient it is robbed of almost all its unpleasantness. It is, however, occasionally somewhat exhausting to the patient.

Oesophagoscopy is absolutely indispensable for the diagnosis and treatment of foreign bodies impacted between the cricoid and the cardia, and scarcely less important in the case of large dilatations, Zenker's diverticula, and the spasmodic stenoses associated with these. If the general examination leaves any doubt whatever, as is often the case, that the patient is suffering from malignant growth, the oesophagoscope must be called into use. It often happens that the patient is in a markedly emaciated state when he reaches the surgeon, and it is therefore necessary to perform gastrostomy (under a local

anæsthetic) before anything else is done. Advantage may be taken of this to perform retrograde œsophagoscopy, or later, when the patient is stronger, ordinary endoscopic examination is made.

Contra-indications.—The majority of these have been discovered in the course of the preliminary examination of the patient, especially the presence of an aortic aneurysm or of cirrhosis of the liver. In the latter condition a great enlargement and congestion of the veins of the lower end of the œsophagus is often present, and exceptional care must be taken, as very slight trauma may lead to severe extravasation of blood. Very great care is needed with patients suffering from uncompensated heart lesions, and with those in whom the respiration is embarrassed, because the pressure of the tube on the larynx and trachea, together with the general excitement, unaccustomed posture, and aspiration of saliva, may cause a sudden increase in the difficulty of breathing, which may prove very dangerous or even fatal. Cases which show an arterial hypertension, especially those with an apoplectic history, are dangerous subjects on account of the unavoidable increase of pressure when the head is low. In a serious case, *e.g.* the firm impaction of a foreign body, all contra-indications are of course overridden.

Another most important condition in which œsophagoscopy is to be avoided is the presence of an acute inflammatory process either in or around the œsophagus. If

FIGS. 36 and 37.—Author's œsophageal bougies (scale = $\frac{1}{2}$), made with bulbous or olive end, increasing by one size (English scale) for each inch of length and attaining a much greater diameter than ordinary œsophageal bougies.



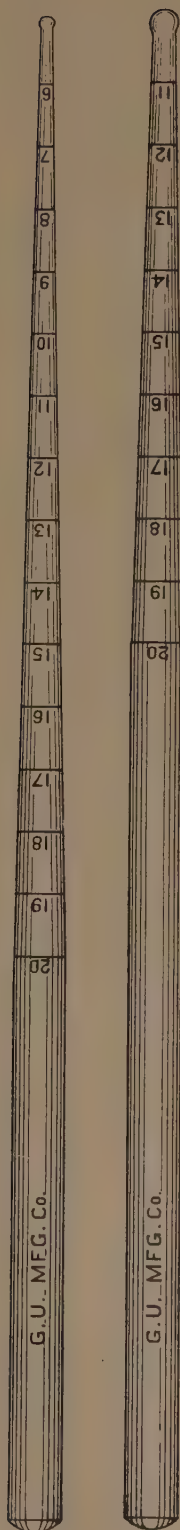
The full size to which the bougie attains is shown in the small illustration.

mediastinitis is present, with increasing fever, excessive pain, and spreading surgical emphysema, œsophagoscopy is no longer necessary, because œsophagotomy or mediasti-

notomy is demanded at once. A fatal result after œsophagoscopy performed upon such a patient would most probably be ascribed to the use of the endoscope, although mediastinitis had previously been present.

A severe kyphosis also renders the operation inadvisable, as does also extreme emaciation.

Preparation of the Patient.—The patient should be prepared as for any operation, special attention having been paid to cleansing the mouth. Artificial dentures and any



loose teeth should previously be removed. As in X-ray examination, the stomach and œsophagus should be empty of food, and therefore the examination should, if possible, be performed in the morning; but the surgeon must always be prepared to wash out the œsophagus or stomach by means of the endoscopic tube. It is advisable to do a Wassermann reaction on all cases except those of impaction of a foreign body, and in all cases an X-ray examination, with or without the swallowing of a radio-opaque substance, according to the type of case, should be made.

Anæsthesia.—The nature of the anæsthesia depends upon the case and upon the skill of the operator. In the vast majority of cases no anæsthetic at all is required in order to perform an œsophagoscopy; but each case must be judged on its merits.

If it is thought essential, a child should be given a general anæsthetic, but for infants under two no anæsthetic is ever necessary. For an adult, if the examination cannot be performed without any anæsthetic at all, a few drops of a 10 per cent solution of cocaine, dripped into the throat with the patient in the dorsal recumbent position, and swallowed, is usually sufficient. If a more thorough local anæsthesia of the pharynx is required, the local anæsthetic is applied by means of a wire bent at a right angle two inches from its extremity. On to the end of this is wound a small piece of non-absorbent cotton-wool, which, having been dipped in the local anæsthetic, is applied to the root of the tongue, the inferior surface of the soft palate, the pillars of the fauces, and the posterior wall of the oral pharynx. This painting is done by touch, and the first application made rapidly, but gently. Then, after waiting for a minute or two, a second application can easily be tolerated, and the swab may be introduced into the hypopharynx, the epiglottis, pyriform sinuses, and upper opening of the œsophagus now being painted. If much irritability is present a third or even a fourth application may be necessary, and, if a little pressure is used and the patient asked to swallow, the swab may be introduced into the mouth of the cervical œsophagus. He should be warned beforehand of the inconveniences which accompany this procedure, especially the unpleasant taste and the sensation of swelling in the throat. An obstruction to the passage of the tube below the mouth of the œsophagus due to spasm of the canal can sometimes be abolished by further applications of cocaine.

General anæsthesia is necessary in very highly-strung patients and in those who have been quite unable to stand the operation of œsophagoscopy with only a local anæsthetic. The personal wishes of the patient must, of course, be taken into account.

The best general anæsthetic is high-pressure gas and oxygen given by means of an intratracheal tube. In addition to the gas and oxygen a little ether may be used. Chloroform need never be employed, except when diathermy is to be utilized. If an intratracheal anæsthetic is not available I prefer the use of a large foot-pump to blow a considerable volume of air through warm ether, and this is quite sufficient to keep the patient very satisfactorily anæsthetized. If, however, the actual cautery or diathermy is

to be used, recourse must necessarily be had to chloroform, which is given by passing a slow stream of oxygen through a Junker's apparatus containing chloroform.

I would repeat that by far the most satisfactory method is to use no anæsthetic at all. The beginner in the realm of endoscopy feels more at home with the patient under a general anæsthetic; but once the technique of the operation has been mastered, the less and less will a general or local anæsthetic be employed.

An injection of morphine and atropine should precede œsophagoscopy, whether performed with or without anæsthesia.

Psychical Paræsthesia.—Throughout the whole operation suggestion must be made to play a large part. The operator should talk calmly and quietly to the patient, in a soothing voice, encouraging him the whole time. The various sensations which he may experience should be mentioned, and he must be assured that there is no pain, and that it is quite impossible for him to choke. He must be asked to breathe deeply and regularly and not to struggle or hold himself rigid, but just to lie as if he were asleep. If the patient is free from apprehension, and his confidence gained, the operation is a comparatively simple one and anæsthesia easily dispensed with. If, on the other hand, the assistants are inexperienced, and instruments have to be asked for instead of being handed automatically, and a rough tone of voice is used, the patient is quickly upset and a general anæsthetic becomes necessary.

Position of the Patient.—In describing the operation of œsophagoscopy, I shall describe the position which I prefer for my own patients, that is, with the patient lying upon the back (dorsal recumbency) on an operating-table with an adjustable head-end. A firm support in the correct position may thus be maintained throughout the operation. I do not have the patient's head hanging over the end of the table, nor leave its support to the hands of an assistant, except in a very small proportion of cases. The table should be of such a height that the operator sits easily at its head and can make the examination in comfort.

An alternative position is with the patient sitting upright or leaning slightly forward in an ordinary chair; or he may sit astride a chair, facing, and with his arms clasping, its back. In either case it is necessary to have an assistant standing behind the patient in order to steady the head. The operator faces the patient and does all his work standing.

Many of the French workers employ the knee-elbow position, the patient kneeling on a firm couch, with the head and upper part of the trunk projecting over the end of the table, the operator kneeling on a low stool in front of him, and working below his level. In this position all fluid contents automatically run out of the œsophagoscopic tube, and saliva dribbles freely from the mouth and does not impede respiration. At some of the Continental clinics I have attended, the patients seemed to me to submit to this position fairly well, but I find that patients in this country much prefer lying upon the back.

Technique.—Before commencing the examination the œsophagoscope tube

and instruments should be sterilized: the whole operation must be conducted with strict observance of aseptic technique.

The surgeon himself should see that nothing is missing, and that everything likely to be required is in working order. This specially applies to the illuminating apparatus, which should always be tested before the tube is passed, and spare electric bulbs should be to hand. The suction-pump should be in working order and in charge of a second assistant. The first assistant should have a full knowledge of the various instruments used, and should prepare the suitable swabs, forceps, etc., for the surgeon.

At every operation of œsophagoscopy or tracheobronchoscopy a tracheotomy set or its equivalent must be at hand. I prefer my laryngotome and tracheotome, the insertion of which is almost instantaneous. It is fully described on page 199.

A cylinder of oxygen is also essential, as in a case of respiratory failure it may be needed very quickly. I prefer to have at hand, not just an ordinary cylinder of oxygen, but an apparatus for giving CO₂ and oxygen under pressure.

It has generally been the custom to discuss at some length the difference between the introduction of the tube by touch and by sight. After ocular introduction has been practised a few times it is obvious that this is by far the better method, and there is no doubt whatever that if an obturator is used, and the tube inserted blindly, a most important section of the œsophagus is not subjected to inspection. The chief rule of endoscopy should be that the eye must always guide the hand. Ocular introduction is alleged to be more difficult: this is quite untrue, and once it has been tried it will become the routine, and its practice will never be departed from. Especially in acute impaction of foreign bodies, which usually occurs in the upper two inches of the œsophagus, ocular introduction is demanded. Only when the lesion is known to be at the lower end of the œsophagus may blind introduction be used. Personally, however, I maintain that blind introduction of an œsophagoscope is never necessary, is fraught with great danger, and ought to be entirely abandoned.

Introduction of the Œsophagoscope.—The œsophagoscope is held lightly in the surgeon's left hand, and only if atropine has been given is any lubricant necessary, *e.g.* a little sterile paraffin. On account of the fact that the œsophagus follows the curve of the cervical and dorsal spine, it must first be brought into a straight line. This is accomplished by raising the patient's head. At the same time the cavity of the mouth and pharynx is also brought into a straight line with the œsophagus by extending the head at the occipito-atlantoid joint. The head is raised either by lifting the head-piece of the table, or by an assistant raising the patient's head and neck with his left hand upon the occiput and then pressing the vertex firmly towards the patient's back. The distal end of the œsophagoscope is now passed gently along the right side of the dorsum of the patient's tongue, and, passing behind the epiglottis, it enters the right pyriform sinus. During this passage the posterior wall of the pharynx is seen and the point of the instrument directed so that it is not scraped. If the

patient's head is supported on the raised head-end of the table, the surgeon's left hand should steady the instrument at the patient's mouth, and pressure by the left thumb be utilized to keep the point of the instrument forwards. The instrument is directed towards the mid-line, and two or three centimetres after passing through the pyriform sinus the lumen of the pharynx disappears. The anterior half of this field is of a whiter colour than the posterior half due to the presence of the cricoid cartilage, the disappearance of the lumen being due to the fact that the superior sphincter of the œsophagus has been reached (Plate I. A). If at this point the patient is asked to swallow the sphincter is seen to open, and no force is needed to cause the tube to slip into the cervical œsophagus (Plate I. B). But no action on the part of the patient is necessary, as gentle steady pressure, together with lifting the tip of the instrument, readily overcomes the tone of the crico-pharyngeus muscle. Immediately the œsophagoscope has passed the sphincter the lumen of the œsophagus is seen to open and close with each inspiration and expiration. As in all direct vision endoscopy, the lumen of the œsophagus must be kept in the axial view of the instrument (Plate I. C).

After the upper half of the œsophagus has been traversed (Plate I. D), the lumen appears to pass anteriorly, and the head and shoulders must now be lowered in order that a further segment of the canal may be examined with its lumen still in view.

The lower third of the œsophagus turns to the left and forwards. In order to keep its lumen in view it is therefore necessary to incline the head slightly to the right, and at the same time to lower the head and shoulders still further. A steady tilting pressure is applied by means of the left thumb directing the tip of the instrument towards the left anterior superior iliac spine, until for a second time the lumen is seen to disappear. On this occasion it is in the form of a slit or rosette (Plate I. E), and the distal end of the œsophagoscope has reached the cardiac sphincter, but not, of course, the anatomical cardia. Again a steady pressure upon this area overcomes the sphincter, and after the further passage of the tube for a centimetre or two the darker red gastric mucosa is seen, and bubbles of gas and mucus make their appearance from the stomach. The further passage of the tube results in a gastroscopy being performed.

A clearer view of the cardia may sometimes be obtained when the patient is lying on the right side, as this tends to straighten out the normal left curvature of the lower portion of the œsophagus.

With the patient lying in the supine position, and the head and shoulders below the level of the trunk, the stomach, œsophagus, or a diverticulum may be satisfactorily emptied or washed out.

Throughout the operation the spatulate end or beak of the instrument is kept uppermost. Immediately beneath the beak of Jackson's instrument is the light, while the aspirating canal is at the bottom of the field, and, provided the aspirating pump is working, a dry field is obtained.

Jackson employs an assistant to control the movements of the patient's

head and neck, the head being held by the assistant's left hand, his right arm passing under the patient's neck and inserting a bite-block (Fig. 38) into the left side of the patient's mouth. Personally, I prefer the firmer support of an easily adjustable head-end to the table, and find few patients who need or care for a block on which to bite.

Oesophagoscopy may be performed while the lumen is distended with air, and this renders the diagnosis of a stenosis easier. By this method also the lumen of the canal is more readily kept in view and detection of the cardia is facilitated. In order that this may be accomplished, it is necessary to have an eye-piece to close the upper end of the endoscope, and a small cannula with a bellows attached, as in the sigmoidoscope, in order to increase the pressure of air in the instrument and oesophagus.



FIG. 38.
Bite-block.

The normal endoscopic views of the oesophagus at various levels are depicted in Plate I.

Retrograde oesophagoscopy may be performed through a gastrostomy. Care must be taken that the opening into the stomach is directed upwards, or difficulty will be experienced in finding the cardia.

Its uses are (1) in the extraction of a foreign body impacted above the cardia when peroral attempts at removal have failed, (2) in the treatment of cicatricial stenosis impermeable from above, (3) for dilatation of cases of cardiospasm, and (4) for examining and determining the lower level of a malignant stricture.

Catheterization.—A large variety of sounds or bougies are available for catheterization of the oesophagus. Illustrations of some of these varieties are shown in Figs. 30, 31, 32, 33, and 34.

Certain rules must be observed before a sound is passed, and this must not be done blindly. X-ray examination should first be made, and oesophagoscopy also performed, and the sound introduced through the stenosed portion of the oesophagus under direct vision. If neither of these methods is available, the patient should be given a silk thread to swallow twenty-four hours before the attempted passage of a sound (Plummer's method, see page 46), the sound used having an orifice at its extremity through which the silk is threaded.

The possibility of an aortic aneurysm should have been excluded, and there should have been no recent oesophageal hæmorrhage.

The main point to remember is that no force must be used. If a stricture is present and the first sound does not pass, smaller ones are used until one passes without difficulty.

If, after the first visual introduction, a catheter is to be passed blindly, this should be done after the patient has fasted for some hours, and therefore the best time is in the morning before breakfast has been taken, in order that food may not be regurgitated and enter the air-passages. Any artificial teeth are first removed, and the patient is reassured that he can and must breathe during the whole passage of the bougie, which is now lubricated with oil and introduced over the dorsum of the tongue and into the pharynx. He is told

to swallow, and gentle pressure easily overcomes the slight obstruction at the mouth of the cesophagus, through which the bougie enters.

Calmness and patience on the part of the operator are essential, and have a great influence upon the successful performance of the operation. In fact the behaviour of the patient may usually be taken as a reflection of that of the surgeon.

(3) CHEMICAL PHYSIOLOGICAL EXAMINATION

Chemical examination of vomited or regurgitated fluid is undertaken in order to detect the presence or absence of hydrochloric acid, free or combined, and the presence of certain fatty acids.

Among the tests performed, the following are the most delicate, giving well-marked colour reactions :

(1) FOR HYDROCHLORIC ACID. (a) **Günzberg's Test**.—A drop of the filtered fluid is mixed with an equal quantity of Günzberg's reagent and evaporated over a water-bath. If even a trace of hydrochloric acid is present the residue acquires a bright red colour. The reagent consists of phloroglucinol 2 parts, vanillin 1 part, and rectified spirit 30 parts.

(b) **Tropæolin Test**.—To a drop of tropæolin-00 in saturated solution in 94 per cent methylated spirit, which has been allowed to dry at a temperature of 100° F., a drop of the suspected fluid is added. If hydrochloric acid is present a violet colour appears when the fluid has evaporated.

(c) **Topfer's Test**.—A single drop of dimethyl-amino-azo-benzene is spread in a thin film on a porcelain slab and a drop of the fluid added. In the presence of hydrochloric acid a red colour develops.

(2) FOR LACTIC ACID. **Uffelmann's Test**.—An ethereal extract of the suspected fluid is made and the ether evaporated; the fluid residue is then added to a few c.cms. of Uffelmann's reagent, which is of a violet colour, and in the event of lactic acid being present the colour immediately changes to yellow. Although other acids, in greater strength than the mere trace of lactic acid which is required to effect the change of colour, may discharge the violet colour, they do not lead to the appearance of the characteristic yellow tint produced by lactic acid.

The reagent consists of a solution of 10 c.cms. of a 4 per cent solution of phenol in 20 c.cms. of distilled water, with the addition of one drop of ferric chloride.

(3) FOR BUTYRIC ACID.—The odour of rancid fat is usually sufficient to indicate the presence of this acid in the vomit or regurgitated material when fermentation and decomposition of milk foods have taken place.

(4) FOR PEPSIN, RENNIN, AND RENNIN-FERMENT.—The detection of these is effected by their digestive and milk-coagulant qualities, and requires more time than do the simple tests outlined above for ascertaining readily the presence or absence of hydrochloric and organic acids.

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CHAPTER IV

GENERAL TREATMENT

VERY little need be said in this place concerning general treatment, as this is dealt with fully under the heading of each of the conditions causing œsophageal obstruction. Three methods, however, must be known, as they are applicable to a large number of œsophageal lesions :

- (1) PLUMMER'S SILK-THREAD GUIDE METHOD, used in the exploration and treatment of œsophageal diseases. In order that the lumen of the œsophagus may be found with certainty in cases in which this is a matter of extreme difficulty, Plummer and others have advised that the patient be given one end of a stout silk thread, some six to ten yards long, to swallow. This thread is made of resistant silk "twist", and is waxed to render it more rigid and less permeable to liquids. Swallowing is facilitated by tying a small glycerine pastille to the end of the thread to be swallowed, but it is usually sufficient to place one end of the thread on the patient's tongue and give several mouthfuls of water to swallow. By making movements of deglutition and drinking water frequently, the patient thus swallows several yards of the thread.

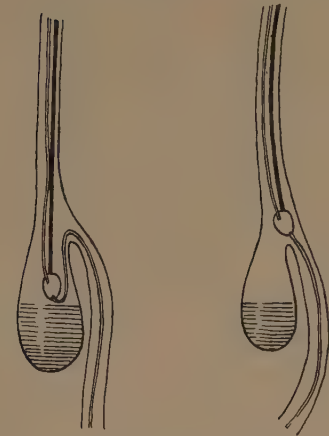


FIG. 39.—Illustration showing use of Plummer's silk-thread guide.

This is done gradually and twenty-four hours are allowed to elapse, at the termination of which time most of the thread has found its way through the œsophagus and stomach and well into the small intestine. Even very tight strictures are generally passed, especially if antispasmodics are given at the same time. One end of the thread is carefully retained outside the patient's mouth. Upon this guiding-silk may be threaded an instrument, either a sound or an examining-bougie, or a fine dilating-bougie. At first the thread is allowed to be slack, and the end of the instrument then passes either into the lumen of the œsophagus or, if any abnormality is present, into a pouch or diverticulum or cul-de-sac which may have



FIG. 40.—Olive perforated for thread.

developed above a stenosis. When the sound has been passed as far as possible, using only the gentlest of pressure, the silk thread is drawn taut; if the instrument is in the lumen of the œsophagus, its position by this manœuvre remains unaltered; if, however, it has deviated from the main course of the œsophageal canal, its position is altered, and it is frequently displaced upwards until it comes to lie in the line occupied by the now tense thread. While the thread is held taut any further pressure upon the sound can only push it in the direct course of the œsophagus, and hence the permeability of the remainder of this canal may be estimated.

(2) SIPPY'S APPARATUS.—In order that gradual dilatation may be accomplished in the œsophagus, Sippy has designed a fine œsophageal probe with a small olive tip. This tip has a hole bored through it, and may be threaded over a Plummer's silk guide. On to the bougie may be passed a number of olives of gradually increasing size until a suitable maximum is reached. Then more olives are threaded, of gradually decreasing size. The passage of this instrument is equivalent to the passage of a flexible conical-shaped sound, whilst withdrawal of it causes gradually increasing pressure from below upwards, and is useful for emptying an œsophageal pouch (see Fig. 41).

(3) GASTROSTOMY.—A common method of alleviating œsophageal obstruction is by the performance of a permanent or semi-permanent opening into the stomach. As the performance of such a fistula is frequently carried out in an unsatisfactory manner, I feel justified in describing what I have repeatedly found to be the method which gives uniformly satisfactory results. These remarks are applicable to either gastrostomy or jejunostomy.

It frequently happens that in a case in which gastrostomy is indicated a general anæsthetic is strongly contra-indicated, either because of definite evidence of lung disease, or of obstruction to the upper respiratory tract, or on account of the extremely wasted condition of the patient. Certainly under these circumstances, and even when no such condition is present, gastrostomy may be performed under the influence of a local anæsthetic. This may be administered: (1) by local infiltration, or (2) by regional nerve block.

In the former, the layers of the abdominal wall are infiltrated seriatim; in the latter, the intercostal nerves are injected as they run in the subcostal grooves at the angles of the ribs, the seventh, eighth, ninth, and tenth intercostal nerves on the left side of the thorax being so treated. The linea alba and umbilicus are soon seen to be displaced to the right, and the whole of the left upper quadrant of the abdominal wall is rendered anæsthetic for operative procedures.

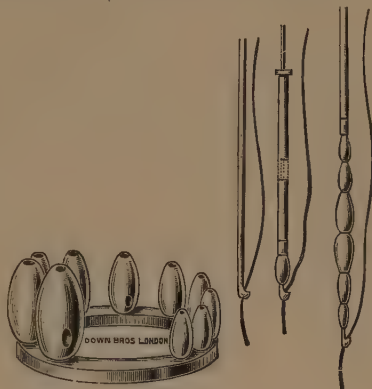


FIG. 41.—Sippy's graduated olives.

The local anæsthetic employed is made up as follows :

R	Novocain	.	.	2.0 per cent
	Sodii chloridi	.	.	0.7 „
	Potassii sulphatis	.	.	0.4 „

To this a few drops of 1 in 10,000 adrenalin may with advantage be added.

A vertical incision three to four inches long is made one inch to the left of the mid-line, its upper extremity reaching to the left costal margin, and each layer of the abdominal wall is divided in the same line. By this means the rectus muscle is divided in the line of its fibres and is not retracted. If the



FIG. 42.—Diagram showing a modification of Witzel's gastrostomy.

incision has been close enough to the costal margin the stomach will be found without difficulty, though it is frequently very contracted and may lie almost entirely under cover of the costal margin. The stomach having been found, it is drawn into the wound, held in place by suitable forceps, and surrounded by damp cloths or a rubber-dam.

It now remains to make an opening into the stomach which will not allow an escape of gastric contents. This is best performed by passing the gastrostomy tube obliquely through the wall of the stomach. In order to do this I use a modification of Witzel's method : an incision is made through the serous and muscular layers of the stomach in a longitudinal direction without injury to the submucous or mucous coats. A little blunt dissection separates these

layers from the submucous layer on either side of the incision for a quarter of an inch. A stab incision is now made through the mucous membrane at the pyloric end of the incision; the gastrostomy tube is passed into the stomach through this and held in position by one or two catgut sutures. The tube is then laid along the prepared groove, and the serous and muscular walls are sutured together in front of it by means of a continuous suture. Now, commencing half an inch beyond the pyloric end of the original incision into the stomach, a continuous Czerny-Lembert suture is employed still further to invaginate the tube and its sero-muscular covering. The stomach must then be firmly sewn to the parietal peritoneum and the posterior sheath of the rectus by two or three sutures. I regard this, and the actual suturing of the tube to the stomach, as most important steps in the operation.

The abdomen is closed layer by layer, leaving the tube projecting. Where the tube passes through the skin I remove two small semilunar portions of skin, which makes subsequent removals and replacings of the tube a matter of greater ease, and prevents stenosis of the opening.

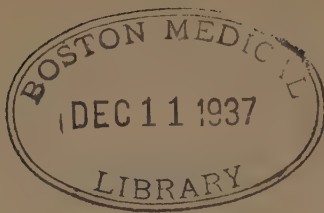
I prefer the use of a large-sized self-retaining catheter, or, better still, a large-sized de Pezzer tube. On the whole, gastrostomy openings and tubes are much too small and inadequate, and I obtain better results by using very large tubes.

It must be remembered that occasionally intragastric manipulation may have to be undertaken after a gastrostomy has been established. In the ordinary way, the groove in which the gastrostomy tube lies is made to run downwards and to the right, but if there is any possibility that retrograde œsophagoscopy may be of value at a later date, the groove should be made upwards and to the right, so that a rigid tube passed along it may easily reach and penetrate the cardia. It might be thought that a gastrostomy opening formed in this direction would be followed by a leakage of the gastric contents, but I find that this does not occur.

After-treatment.—Feeding through the gastrostomy tube may begin immediately. I start with one to two ounces of glucose in water every half hour for the first six to eight hours. Then albumen water, peptonized and citrated milk, and egg and milk may be given in gradually increasing quantities and diminishing frequency. After twenty-four to forty-eight hours oatmeal and finely minced foods may be given, always accompanied by liberal amounts of water, sugar, milk, and eggs.

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CHAPTER V

ŒSOPHAGEAL OBSTRUCTION DUE TO CONGENITAL MALFORMATIONS

CONGENITAL malformations of the œsophagus are by no means extremely uncommon, and usually manifest their presence within a few days of birth ; almost all prove rapidly fatal. Life may, however, be saved in some of the rarer cases by prompt intervention, and as an illustration of this I append at the end of this chapter details of a case of complete congenital œsophageal obstruction, operation, and recovery, followed by pyloric stenosis, a second operation, and recovery.

CONGENITAL MALFORMATIONS

There are seven types of congenital malformation :

1. Total absence of the œsophagus.
2. Doubling of the œsophagus.
3. Œsophago-tracheal fistulæ.
4. Partial obliteration of the œsophagus.
5. Diverticulum formation.
6. Simple congenital strictures.
7. Membranous or valve-like strictures.

1. **Total Absence of the Œsophagus.**—This occurs only in acardiac monsters, in whom the head also is usually missing, and this type is of no importance.

2. **Double Œsophagus.**—Blasius (1674) records a case of a new-born infant in which the middle two-fourths of the œsophagus was double ; this, however, did not cause any obstruction. I can find no record of any similar case.

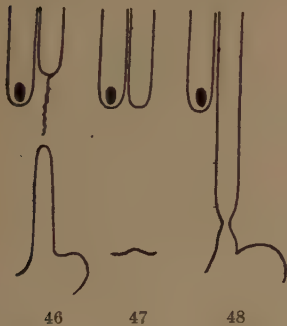
3. **Œsophago-tracheal Fistulæ.**—As was stated in the section dealing with the development of the œsophagus (p. 15), the two lateral septa of the cephalic extremity of the fore-gut, which meet and fuse in order to differentiate the upper half of the œsophagus from the trachea, have their point of ultimate fusion at the lower end of the trachea. In this situation they may fail to meet, and hence an œsophago-tracheal fistula results. (a) If the œsophago-tracheal septa develop in their normal plane, apart from the fistula, both organs are normal (Fig. 44). It rarely happens that a fold of mucous membrane covers this opening. (b) If the plane of development of the œsophago-tracheal

septum is faulty, the latter becomes attached to the posterior wall of the fore-gut and so leads to obliteration of the upper part of the œsophagus, together with a fistulous communication of the lower part of the œsophagus with the trachea. This is the commonest congenital anomaly of the œsophagus (Fig. 45).

4. Partial Obliteration of the Œsophagus.—(a) Simple blind ending of the upper part of the œsophagus may occur, possibly as a result of a deviation in the lines of development of the two lateral septa. In these circumstances the proximal end of the lower part of the œsophagus is blind also. Another explanation is that the rapid growth of the lung-buds has ruptured the continuity of the slender tube which is the primitive œsophagus. It sometimes happens that the upper and lower blind ends are united by a strip of muscle tissue (Fig. 46). This would appear to be due either to a rupture of the inner layer of cells or to a failure of the epithelium in a portion of the œsophagus to undergo vacuolization, and therefore the lumen, which, according to some observers, has been entirely obliterated at one stage of development, never again becomes patent. The outer layer of cells, however, persists, and forms a thin strand of muscle. (b) Obliteration of the œsophagus may occur only from the level of the tracheal bifurcation downwards, the œsophagus above this level being normal (Fig. 47).



FIGS. 43-45.—Diagrams showing development and commonest abnormalities of the œsophagus. (Stipled area = œsophago-tracheal septum.)



FIGS. 46-48.—Diagrams of further congenital anomalies. (No. 48 = one of the curable types.)

These varieties of malformation of the œsophagus are of interest because of their frequency and because of the embryological factors concerned in their production. Clinically, however, they are of small importance because no treatment is of any avail. These anomalies are often associated with other congenital malformations—for example, Meckel's diverticulum, imperforate anus, and duodenal atresia.

In Types 3 and 4 above severe interference with swallowing is occasioned; gurgling sounds are heard when fluid enters the trachea as soon as the infant swallows, followed by violent attacks of coughing and vomiting. If feeding is persisted in the child may be asphyxiated or pulmonary complications may supervene. Death occurs either

from these or from inanition.

CURABLE TYPES

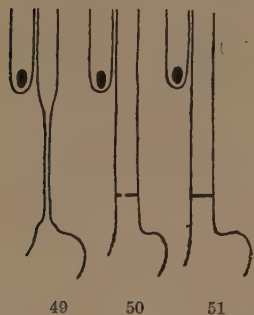
I shall now describe the varieties of congenital anomalies of the œsophagus which, although very rare, yet are of great clinical importance because their

early recognition and prompt treatment may make all the difference between the life and death of the patient.

5. **Congenital diverticulum** at the pharyngo-œsophageal junction is extremely rare, occurs in the same position as the acquired Zenker's pulsion diverticulum, and eventually produces similar symptoms. It is possibly atavistic in origin, being present normally in the hog and some other animals. It differs from a true Zenker's diverticulum by having a complete muscular covering, but its treatment is the same as that of the acquired form.

6. **Simple Congenital Strictures.**—In these cases there is a definite narrowing of the whole circumference of the œsophageal wall at one or more places. This type is very uncommon. The narrowed portion may be either circular and confined to only a small area (Fig. 48) or may extend through more or less of the length of the œsophagus (Fig. 49). Rarely is the upper end of the gullet the affected region; more commonly it is the lower segment. The symptomatology is similar to that of the succeeding variety.

7. **Membranous or Valve-like Strictures.**—Membranous or valve-like strictures are, according to Kraus, very rare. The membrane may form a ring-like fold (Fig. 50) or a complete diaphragm (Fig. 51), and is generally situated a very short distance above the cardia. The condition has been known to be associated with an œsophago-tracheal fistula, but may be the only abnormality.



FIGS. 49-51.—Diagrams showing remaining three curable types of congenital anomalies of the œsophagus.

The *ætiological factors* concerned in the formation of simple congenital strictures and of membranous strictures, whether complete or incomplete, would appear to be one or more of the following errors of development.

1. The "mere sphincter" between the pharynx and the œsophagus in a 4-mm. embryo referred to above does not elongate equally, but leaves a stenosis of one portion of the canal.
2. The obliterated tube fails to canalize at one place.
3. Although canalization occurs, yet the inner layer of cells fails to transfer its mitotic activity to the outer layer, and therefore a local area of œsophageal wall remains without coalescence of the local vacuoles, and stenosis results.

SYMPTOMS AND DIAGNOSIS

In both simple congenital and annular membranous strictures cases have been recorded in which symptoms were not produced until, after weaning, the child was found to be unable to take solid food, which was almost immediately regurgitated. By feeding solely upon fluids, chiefly milk, life has been maintained, and patients have lived for many years before the true nature of the lesion has been discovered. These patients are very under-developed and thin, and males are said to show only slight masculine characteristics.

On the other hand, depending upon the degree of atresia, symptoms of œsophageal obstruction, notably dysphagia and the regurgitation of fluids, may make their appearance as soon as fluid is given to the new-born infant.

If the membranous stricture is not annular but in the form of a complete diaphragm, symptoms of complete œsophageal obstruction are always present from birth. The precise diagnosis of the actual type of œsophageal malformation which is present can only be arrived at by means of a careful X-ray examination and œsophagoscopy, and should not be left until the post-mortem examination is reached.

COMPLICATIONS

If left untreated all cases of complete occlusion die of inanition; also the more severe stenoses. With an inadequate lumen the stagnated food may produce a marked œsophagitis in the portion of the œsophagus which is dilated above the stricture. The ulcerative process may actually cause perforation. In rare instances a pressure diverticulum is formed above the stenosis, as in one of my cases (see p. 129). Probably apart from this secondary dilatation of the œsophagus a true congenital dilatation does not occur.

TREATMENT

(a) For Simple Congenital and Annular Membranous Strictures

Simple strictures are best treated by slow, gradual dilatation by means of bougies. This produces a more permanent result, and much less damage, than when dilatation is performed rapidly. Rapid dilatation causes ulceration at the site of the lesion, and is followed by fibrosis, contraction, and a tighter stricture than was present before treatment commenced. In addition, too rapid dilatation may cause perforation or rupture of the œsophagus.

Treatment, therefore, consists in the passage of carefully graduated bougies. At the first sitting a bougie which only comfortably fits the stricture is passed under direct vision through the œsophagoscope. At subsequent sittings, which should take place once or twice a week, bougies may be passed blindly, provided there is not a great deal of dilatation of the œsophagus or diverticulum formation above the stricture. Commence with a bougie of the same size as the one passed through the œsophagoscope, and when this has remained *in situ* for a few minutes, replace it by a bougie of one size larger; and at each subsequent sitting pass, if possible, one bougie a size larger than the largest previously used. In no circumstances should any force be used.

Annular membranous strictures may respond to similar treatment, but, as with this type of stricture considerable dilatation of the œsophagus is usually present, and the lumen is always eccentric, the bougies must invariably be passed under direct œsophagoscopic vision. This type of stricture lends itself to internal œsophagotomy, whereas with simple strictures involving a considerable length of the œsophageal canal this procedure is fraught with much danger. A ring-like stricture may also be treated successfully by electrolysis.

In an emaciated, dehydrated patient, or if in spite of great care and patience improvement does not occur, a gastrostomy is necessary. This allows rest to the œsophagus, permits feeding of the patient, and a retrograde œsophagoscopy may be performed. By this means, or by peroral endoscopy, a filiform bougie to which is attached a silk thread is passed through the stenosis. The thread is drawn upwards or downwards, as the case may be, until one end projects out of the mouth and the other through the gastrostomy opening. Each end of the thread is attached to the two ends of a fine piece of rubber tubing, and therefore a continuous or endless chain is present. By means of the thread the tubing is pulled hard enough to render the diameter of the rubber small enough to pass the stenosis. When tension on it is relaxed its length is diminished and its diameter increased, and it then exerts continuous pressure on the stricture and causes further dilatation. The rubber is left in position

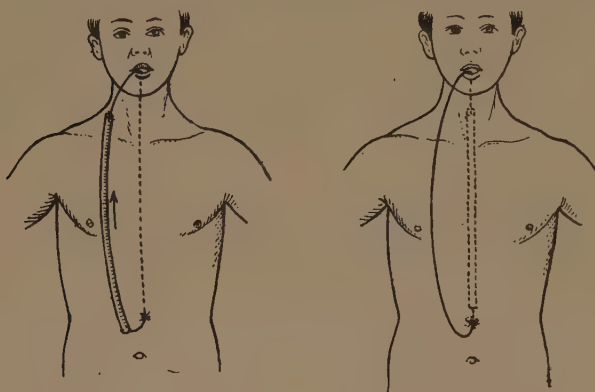


FIG. 52.—Congenital stricture of œsophagus treated by rubber tube.

for an hour or two every day, and then by pulling upon the thread the rubber is displaced from the œsophagus and its place taken by the thread. Every few days the tubing must be replaced by one of larger calibre until sufficient dilatation is obtained (Fig. 52).

(b) A complete membranous diaphragm in a new-born infant may be perforated by means of the œsophagoscope or a bougie. In this way I

have recently treated with success an infant less than two days old suffering from this condition.

CASE OF COMPLETE MEMBRANOUS DIAPHRAGM

The patient was a female child, who was born on the evening of January 18, 1928. The mother was a primipara, and the labour, which was not abnormal in any way, lasted twenty-one hours. The child weighed $7\frac{3}{4}$ lb., and appeared to be perfectly healthy.

Throughout the whole of the following day attempts were made to feed the child at regular intervals. At no time would she suckle the breast, and when given teaspoonfuls of milk and water the infant appeared to have great difficulty in swallowing, and regurgitated the fluid as soon as it had been taken. On one occasion only was there a small quantity of blood, but on each occasion she coughed and choked a great deal and became very cyanosed.

I saw the child with Dr. Henry Robinson about noon on January 20, when she was just forty-two hours old. Outwardly she appeared quite normal; but on feeding with a teaspoonful of water she coughed, became cyanosed, retched, and retained none of it. The child obviously had a congenital abnormality of the œsophagus,

and this was most likely to be in the nature of an œsophago-tracheal fistula. The infant was twenty-five miles from London, and X-ray examination was not immediately available; but, having an œsophagoscopic outfit, I decided to perform œsophagoscopy forthwith. This was done without, of course, any anæsthetic, using a 4-mm. tube (Jackson's pattern), which passed quite freely down to and beyond the level of the bifurcation of the trachea. About 1 in. below this level, however, the lumen became obstructed by a glistening membrane with a "mother-of-pearl" appearance, which was at first thought to be inspissated mucus. Careful swabbing, however, showed it to be a solid structure, and no opening could be found in it (Fig. 53).

By pressing firmly with the endoscope the membrane was ruptured and normal œsophageal mucosa was seen below it. Gastric mucosa was easily recognized after the tube had been pushed about 1 in. further. On withdrawing the œsophagoscope a few drops of blood obscured the view of the wall of the gullet at the level where the membranous diaphragm had previously been seen. No other abnormality was detected in the pharynx, larynx, or œsophagus.

One ounce of exhausted breast milk was now given to the infant, who swallowed it normally and retained it. This appeared very satisfactory, and we thought it worth while to investigate the case still further by means of X-rays. With the late Dr. Robert Knox we examined the infant the same afternoon with the fluorescent screen while she swallowed an emulsion of bismuth, and a definite narrowing of the lumen of the œsophagus, together with a slight delay in the passage of the bismuth, was noted about an inch above the stomach. No other abnormality of the upper alimentary tract could be detected, and we were able to give a fairly good prognosis. This was borne out by the fact that the child, although she persisted in refusing the breast, swallowed and retained fluid normally, and scarcely vomited again. Temperature, pulse, and respiration were normal throughout.

The baby, which had lost about $\frac{3}{4}$ lb. in weight, made steady progress until four weeks later, when she weighed 8 lb. She then began to vomit forcibly through both the nostrils and the mouth. A gastric tumour was visible and a pyloric tumour palpable on the second day of these symptoms, and hypertrophic pyloric stenosis was diagnosed. Laparotomy, on February 18, confirmed this, and no other abnormality of the stomach or duodenum was found. Rammstedt's operation under gas and oxygen anæsthesia was followed by an uninterrupted recovery. For some considerable time after this the child was difficult to feed, but has now settled down and is doing well; at five months old she weighed 11½ lb.

The points which I wish to emphasize with reference to this case are:

1. So far as I know, this case is unique; I can find no record in the literature of any previous case which has survived.

2. Congenital œsophageal malformations are not so rare as might be supposed.

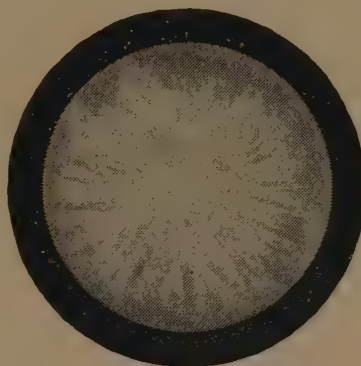


FIG. 53.—Membrane as seen by œsophagoscope.

3. The symptoms of all varieties are almost identical.
4. Some cases which are curable are probably diagnosed as being incurable.
5. A careful examination by means of prompt œsophagoscopy, with or without X-ray examination, should lead to a cure of a number of cases for which at present no treatment is undertaken.

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CHAPTER VI

ACUTE OESOPHAGEAL OBSTRUCTION

A. IN THE LUMEN OF THE OESOPHAGUS

PATHOLOGY

THE most common cause of acute oesophageal obstruction is the accidental swallowing of a foreign body. Carelessness accounts for almost all cases, and no foreign body should ever be placed in the mouth, nor should any object of small size be left within reach of a child. The foreign bodies which are swallowed by children are usually coins, metal toys, pins, and the like. In an adult, an ill-fitting tooth-plate is apt to become detached and slip into the oesophagus, especially at night, and solid particles of food which have been swallowed too hastily, for example bones of meat or fish, are also frequently arrested. The impaction of food particles should always raise a strong suspicion of a pre-existing stenosis of the oesophagus. Of course, a large proportion of foreign bodies pass without giving rise to any symptoms, but when impaction in the oesophagus occurs, this is a source of great danger.

A foreign body tends to stop opposite one of the five sites of normal anatomical narrowing of the lumen, the most common being at the upper aperture of the thorax. Unskilful attempts at extraction may push a foreign body further down the oesophagus.

Complications.—As a rule, soon after impaction, a foreign body causes complications accompanied by symptoms of great urgency.

Above the level of the impaction, food stagnates, and its decomposition is an additional source of danger. The overflow of oesophageal contents may enter the larynx and give rise to pulmonary complications.

As soon as the foreign body is arrested, rapid oedema and swelling of the oesophageal wall occur, together with spasm of one or both sphincters, more especially the superior.

The sharp edges of a foreign body are very liable to cause ulceration, followed by the formation of a submucous abscess, or perforation of the wall of the oesophagus. This is followed by peri-oesophageal inflammation and the formation of a phlegmon in the neck and thorax.

Actual erosion of the trachea or a bronchus may occur, with fistula formation.

The inflammation or suppuration may infect the pleural cavities or pericardium.

Perforation of a large blood-vessel by a sharp foreign body has been known to occur.

Lastly, if the foreign body is removed after ulceration has been produced, but in time for the patient's life to be saved, the ulceration is very liable to be followed by the formation of a fibrous stricture.

DIAGNOSIS

Symptomatology.—The chief complaint in these cases is the sense of the presence of a foreign body, together with the history of a sudden attack of choking, often accompanied by coughing. The patient also usually complains of more or less dysphagia, which has appeared suddenly, and, depending on the size of the foreign body, may be complete or may apply only to solids.

A certain amount of discomfort usually accompanies the dysphagia. This is most severe when the foreign body is situated at the upper end of the œsophagus, owing to the spasm of the sphincter formed by the lower fibres of the inferior constrictor muscle. In these cases the pain is referred fairly accurately to the site of the lesion. If it is lodged above the superior sphincter, the larynx is irritated or even compressed, and more or less dyspnœa is present, often accompanied by alteration in the voice. If below this level, dyspnœa is also present if the foreign body presses upon the trachea. Respiratory symptoms are absent in uncomplicated cases of foreign body impacted in the œsophagus below the level of the fifth dorsal vertebra.

Repeated vomiting frequently accompanies the arrest of a foreign body, especially if this occurs in the upper part of the canal.

In the lower segments of the œsophagus, less pain, and sometimes no discomfort, is produced, but if present the pain may be referred to any portion of the sternum, or may be felt posteriorly between the shoulder-blades.

When the vomit is streaked with blood the œsophagus is either lacerated, eroded, or ulcerated.

Sooner or later, in an untreated case, symptoms of one or more complications make their appearance, and are usually those of acute œsophagitis or involvement of the peri-œsophageal tissues.

It is often very difficult to determine accurately whether a local œsophagitis is present, or whether a peri-œsophageal phlegmon is commencing. In both conditions severe pains are experienced in the chest, and the patient is found to have an increased temperature and pulse-rate. He must be watched with great care for some time, as it frequently happens that the simple œsophagitis arising from foreign bodies, or after their extraction, subsides, notwithstanding the pain and fever. The important points to note are the rate of the progress of the fever, together with the pulse and respiratory rates, which are of more consequence than the actual degree of the temperature at the moment. Every hour during which there is no change may be taken as a favourable sign. On

the other hand, a steady increase of symptoms will indicate the probability of mediastinal complications. In this connexion it is important to note that œsophageal pain is increased intolerably by the act of swallowing, whereas mediastinitis causes continuous pain with increasing rapidity of respiration.

An actual tumour may be felt in the neck, and surgical emphysema frequently makes its appearance.

Involvement of a large vessel is shown, as a rule, by slight premonitory hæmorrhages, which recur until a final severe and possibly fatal bleeding takes place.

Quite characteristic signs and symptoms are produced by implication of the air-passages, pleuræ, and pericardium.

The formation of a fibrous or cicatricial stricture, its symptomatology, diagnosis, and treatment are discussed elsewhere (pp. 149-159).

Actual Diagnosis.—A history of swallowing a foreign body is often unobtainable, especially in children, but the sudden onset of dysphagia, with no other cause, is very suggestive, and a most thorough routine examination must be made in all suspected cases.

The "first-aid" practice is to invert the patient and endeavour to dislodge the foreign body by shaking. This is only efficacious if the intruder is still in the pharynx. Sometimes a foreign body can be felt through the neck and squeezed upwards until it is within reach of the finger.

The first step is to take a careful history of the case, and to obtain, if possible, an exact duplicate of the foreign body which is said to have been swallowed. Secondly, a general examination of the patient is undertaken in order to exclude such conditions as aortic aneurysm and tabes (cf. laryngeal crisis).

This is followed by an X-ray examination, and as a rule the position and size of a foreign body, if present, can be accurately determined. Occasionally, however, the impacted material is not radio-opaque, and a negative examination is of no importance whatever. As in other radioscopic examinations, the patient must be placed in the antero-posterior, lateral, and oblique positions. If no foreign body is detectable the patient should be made to drink a bismuth emulsion, the stream of which may be seen to stop or to become divided at the level of the obstruction, or a small quantity may adhere to the surface of the foreign body. This is more likely to happen if a few shreds of cotton-wool have been added to the radio-opaque drink.

If this still fails to localize a suspected foreign body, a capsule containing bismuth should be swallowed, and this may demonstrate the level of obstruction when a fluid substance has failed to do so.

If the radioscopic examination prove negative a plate should be taken; this will often show a faint shadow which was undetectable on radioscopy.

Examination carried out along these lines is almost invariably sufficient to determine if a foreign body is present, and if so, its position, size, and shape. If a foreign body is present, or if none is demonstrable but the history and symptoms are sufficiently suggestive, a laryngoscopy and œsophagoscopy should be undertaken as soon as any preliminary shock has passed off.

There is no real contra-indication to this procedure in a case of impacted foreign body, but the general examination of the patient should have revealed the contra-indications to œsophagoscopy in non-foreign-body cases (p. 38), and if any is present, still greater care in the use of instruments is called for.

Laryngoscopy and œsophagoscopy are practised, not only in order to detect the suspected foreign body, but also to extract it. Neither should be used for purposes of diagnosis only, but removal of the foreign body must be carried out at the same time. Their uses are discussed under the heading of treatment.

Unless all other methods are unobtainable, bougies, sounds, probangs, and coin-catchers should be avoided, as they frequently displace the foreign body downwards, and may actually perforate the wall of the gullet. They are equally dangerous with or without the fluoroscope, except when this is utilized in a double plane.

TREATMENT

The first treatment to be instituted is that of combating the shock from which the patient may be found to be suffering, as a result of the recent attack of choking, from having travelled some distance to the hospital, or following a previous attempt at extraction.

A case complicated by acute œsophagitis, or commencing acute peri-œsophageal infection, also demands palliative treatment before œsophagoscopy is undertaken. Antiseptics may be given by the mouth, the most useful method being to place upon the tongue at frequent intervals a powder consisting of ten grains of bismuth subnitrate with one-tenth of a grain of calomel.

If the odynphagia is severe, a local anæsthetic may be added, consisting of two grains of a powder of equal parts of orthoform and anæsthesin.

The *removal of a foreign body* from the œsophagus may be undertaken—

(A) Through the mouth (by means of the endoscope).

(B) Through the stomach.

(C) By œsophagotomy.

(A) The most satisfactory method is removal by a direct vision œsophagoscope passed through the mouth (Plate I. F), and not until this has failed at more than one attempt should the alternative methods be considered.

Chevalier Jackson has seen one thousand eight hundred cases of foreign body, all of which have been successfully treated by means of endoscopy. His description of the technique and methods in various cases is the best that I have found, and in describing the principles and more important details I have freely referred to his standard, stimulating, and masterly work *Bronchoscopy and Esophagoscopy*. As already detailed, the instruments must be sterilized, and include œsophagoscopes, bronchoscopes, laryngoscopes, a tracheotome or tracheotomy set, and a cylinder of oxygen. Before the search is commenced, Jackson strongly advises practising the removal of an exactly similar foreign body from the interior of a rubber tube of approximately the same size as the patient's œsophagus, and not until this has been practised for a long time and successfully accomplished should the treatment of the patient begin.

Search must be exceptionally careful, and care taken that the œsophagoscope does not push a fold of mucous membrane in front of it, thereby causing the foreign body to be overlooked.

The fundamental principles to be borne in mind are as follows :

- (1) Jackson's formula of the trailing point. A trailing point will not perforate the œsophagus, whereas a point carelessly pulled upon is almost bound to do so.
- (2) In extracting a foreign body it must be kept closely against the tube mouth.
- (3) Forceps should be tested to make sure that their grip is firm and secure.
- (4) The most serious immediate complication is asphyxia, and this is due either to the pressure of the foreign body or to the faulty direction of the endoscope.
- (5) The foreign body must be manipulated without damage to the œsophageal wall until it can be withdrawn in close apposition to the tube mouth, still without damage to the œsophagus.
- (6) Whatever the result of the intra-œsophageal manipulations, no harm must be done.

Special Types of Foreign Bodies.

(1) Large foreign bodies.

These are most easily removed through a large œsophagoscope, for example Mosher's. They often require fragmenting or comminuting *in situ* by means of large cutting-shears, and then extracting piecemeal.

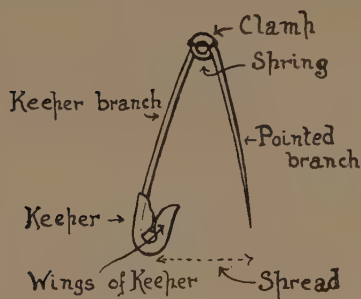


FIG. 54.—Anatomy of the safety-pin.

(2) Food particles.

In the absence of a pre-existing lesion impaction of food is very uncommon. The particles should be removed by means of crocodile forceps.

(3) The open safety-pin.

The anatomy of the safety-pin is shown in the accompanying diagram (Fig. 54).

(a) With the point down. It is rarely found thus, but is easily removed by drawing the pin upwards by means of its spring into the œsophagoscopic tube.

(b) With the point uppermost.

Jackson gives sixteen methods of dealing with the open safety-pin lodged with its point uppermost. These may be described as follows :

I. Methods of removal of the pin whole.

II. Methods of removal by mutilation of the pin.

I. REMOVAL OF THE PIN WHOLE.

(a) *By sheathing both ends of the pin into the mouth of the œsophagoscope.* One or other branch of the pin is placed against the lip of the tube wall ;

the other branch is held by means of forceps against the tube mouth, and the œsophagoscope and pin are withdrawn together (Fig. 55).

(b) *By version of the pin* (1) in the œsophagus ; (2) in the stomach.

(1) The pin may be turned in the œsophagus (i.) vertical to the plane of expansion.

If the pin is of small size it is caught by its spring end with rotation forceps, which being gently pulled upon causes the pin to turn over, and it is then easily withdrawn into the œsophagoscope.

(ii.) In the plane of expansion.

Rotation forceps are used to pull the spring towards the mouth of the

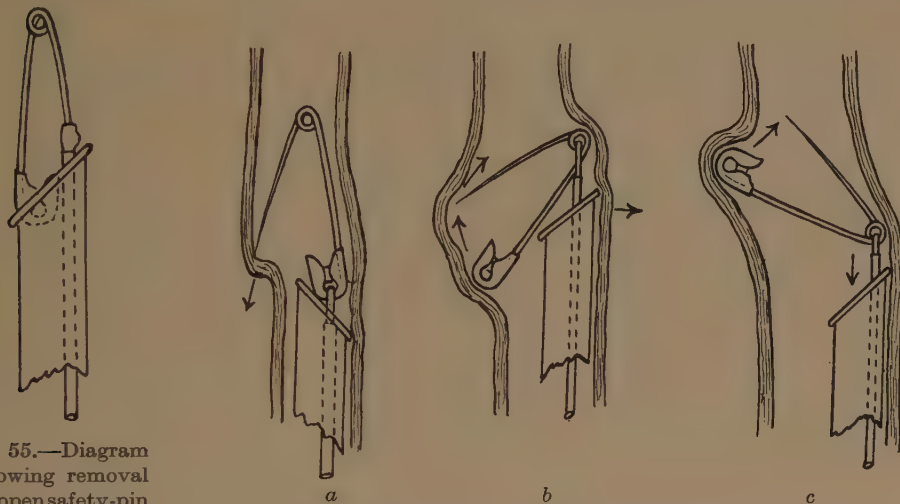


FIG. 55.—Diagram showing removal of opensafety-pin with point uppermost by sheathing both ends of the pin in mouth of œsophagoscope.

FIG. 56.—Diagram showing removal of open safety-pin with point uppermost by version of the pin in the plane of expansion. a, Incorrect pull, perforation of wall of œsophagus certain; b and c, correct pull, showing rotation and trailing point. (After Jackson.)

œsophagoscope, which is used to press the wall of the œsophagus away from the pointed end and allows the point to trail through 180 degrees (see Fig. 56). This, according to Jackson, is the most frequently satisfactory method.

(2) *Version in the stomach.*

If the spring of the pin is caught by rotation forceps and pushed into the stomach, the pin then lies freely, and on being pulled upon readily rotates and is withdrawn into the œsophagoscope.

(c) *By straightening.*

If the keeper of the pin is pulled upon by rotation forceps, the pointed branch is straightened by pressure against the inferior aspect of the mouth of the tube.

(d) *By dangling freely by the keeper.*

If the safety-pin is not longer than the transverse diameter of the œsophagus,

and the keeper is caught with rotation forceps so that it hangs freely, its point may do no harm. This is probably the least satisfactory method.

(e) *By sheathing the point.*

In this method the point is seized by Tucker forceps, and drawn into the œsophagoscope in such a way that only the smooth keeper and keeper branch remain between the tube and the œsophagus, and will do no harm.

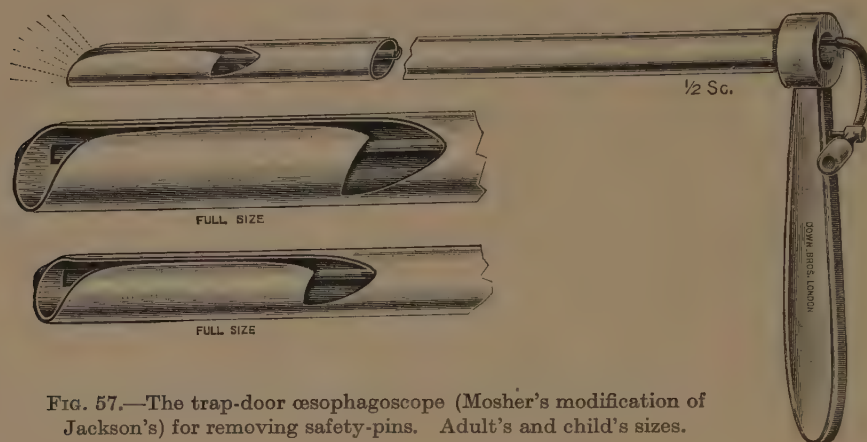


FIG. 57.—The trap-door œsophagoscope (Mosher's modification of Jackson's) for removing safety-pins. Adult's and child's sizes.

(f) *By sheathing the point in the trap-door œsophagoscope, i.e. an œsophagoscope with a narrow slit extending about one inch along its ventral aspect at the distal end (Fig. 57).*

(g) *By closing the pin in situ.*

This may be performed—

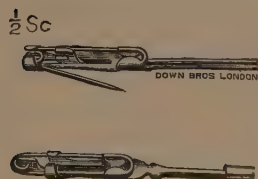


FIG. 58.—Safety-pin closer.

(i.) By manipulating it with forceps against the mouth of the œsophagoscope.

(ii.) By slipping a ring over it, the so-called erecting ring-closer.

(iii.) By the Arrowsmith closer. (See Fig. 58.)

(h) *By seizing any portion.*

Only with a very small pin is this justifiable. It is specially useful above the level of the cricopharyngeus muscle even with larger pins.

II. BY MUTILATION.

(a) *By buckling a very thin pin.*

(b) *By breaking the pin.*

For obvious reasons this is unsatisfactory.

(c) *By dismembering the pin*, removing, for example, the clamp or the keeper.

(d) *By cutting the pin close to the spring.*

There is then no expansion and the two portions are easily removed.

(B) When a foreign body cannot be displaced or extracted through the mouth, attempts may be made to reach it by opening the stomach. If perforation of the wall of the œsophagus or infection of the surrounding tissues has occurred, œsophagotomy is indicated.

Gastrotomy.—When a foreign body is more than thirteen inches from the incisor teeth it may easily be removed through an opening made into the stomach. The cardiac orifice is dilated by the finger or by a suitable dilating speculum. A little traction on the stomach, together with flexion of the spine, usually renders the cardiac orifice fairly easy of access, and, provided that suitable instruments are available, any foreign body which has been able to negotiate the mouth of the œsophagus can be extracted by this route.

(C) **Œsophagotomy.**—This operation is rarely performed and, with greater skill with the œsophagoscope, should never be needed. It may be indicated for the removal of irregular jagged substances impacted in the upper half of the gullet, especially if complicated by the presence of a suppurative or phlegmonous œsophagitis or peri-œsophageal suppuration. By this route it is possible to reach six inches below the level of the cricoid. The actual operation is not difficult, but there is great danger of infection of the cellular tissues of the neck. An incision is made along the natural crease of the neck a little above the clavicle on the left side. The underlying investing layer of deep cervical fascia is incised. The sterno-mastoid muscle and the carotid sheath and its contents are retracted outwards,—care being taken to avoid injury to the inferior thyroid artery, recurrent laryngeal nerve, and thoracic duct,—while the trachea and thyroid gland are displaced to the right. The œsophagus is now seen lying immediately behind the trachea, and the whole area is packed with gauze moistened with a solution of 1 in 500 perchloride of mercury. A longitudinal opening is made in the œsophagus, and the lumen dilated with suitable forceps to allow extraction of the impacted body. Closure is effected by absorbable sutures, preferably using a double layer, one for the mucous coat and one for the muscular coat. The more septic the condition of the teeth, the greater is the liability to a cellulitis of the neck, and in all cases the field of operation must be subject to antiseptic treatment and free drainage. The original gauze packing must be removed, and a thin strip of gauze soaked with a solution of 1 in 500 perchloride of mercury laid round the cavity. The object of this is to promote the rapid formation of adhesions, and it may be removed at the end of twenty-four hours. Into the cavity are also placed one or more drainage tubes, and the remainder of the cavity is packed with pure boracic acid crystals. Only one or two sutures will be needed at the ends of the incision. For a short time a fistula persists, especially if ulceration has taken place, and the wound should be irrigated every twelve hours with five to ten ounces of 1 in 500 perchloride of mercury, followed by a similar quantity of normal saline, and the whole wound again packed with boracic acid. The tube or tubes need not be left in longer than three days, but the irrigation should be continued for a further two or three days. If this is done the fistula will close spontaneously. Nothing is allowed to be

swallowed for at least three, and preferably five, days. Rectal salines, with glucose and bicarbonate of soda, are usually sufficient to keep the patient free from thirst, but may be supplemented by hypodermatoclysis.

Mediastinal Œsophagotomy.—This operation must be rarely, if ever, needed. If it were, the technique of approach would be as described for mediastinal œsophagectomy (pp. 201 *et seq.*).

B. AFFECTIONS OF THE WALL

Acute œsophageal obstruction may occur as the result of an affection of the wall of the œsophagus due to the swallowing of corrosives, caustics, or very hot fluids, or to an acute œsophagitis.

PATHOLOGY

Acute œsophagitis gives rise to œsophageal obstruction because, in all forms except the very mild, spasm occurs at either or both sphincters or at any intervening portion of this passage.

The degree of inflammation varies from slight and superficial to phlegmonous, with cellulitis of all the wall of the organ.

1. **Mild œsophagitis** is usually generalized, the epithelium being red and œdematous and producing a large secretion of mucus. If this process increases it leads to ulcerative œsophagitis.

2. **Ulcerative Œsophagitis.**—This condition may follow an acute infection, but is present from the outset in cases of severe burns. The mucosa and even the submucosa become necrosed over small or large areas, and sometimes perforation occurs; large portions of the inner wall of the œsophagus come away, and occasionally casts of almost the whole passage. With such extensive raw areas healing is necessarily slow and accompanied by a large amount of fibrous tissue formation. Healing rarely takes place without the formation of one or more strictures, which may, of course, be sufficient completely to obstruct the lumen, or may be so slight that no symptoms supervene. A severe infection and extension of the inflammatory process cause phlegmonous œsophagitis or the development of fistulæ. Rupture of the œsophagus has been known to occur after ulcerative œsophagitis.

3. **Phlegmonous Œsophagitis.**—This may be

(a) Localized.

(b) Generalized.

(a) A *local abscess* may develop in the œsophageal wall as a sequel to a pre-existing acute ulceration, which may have been primarily infective in origin, but is more commonly due to a foreign body.

As a foreign body most frequently becomes impacted immediately below the mouth of the canal, the abscess develops in the cervical portion of the œsophagus. Commonly it arises posteriorly and spreads on either side and forwards, compressing both the œsophagus and the trachea, and causing a

brawny swelling on either side of the mid-line of the neck. The abscess usually bursts into the lumen of the gullet, and leaves a sharply-defined cavity, with induration around it in proportion to its chronicity. Multiple local abscesses may be present at the same time. Occasionally the pus tracks outwards, and may infect the mediastinum, pleura, or pericardium, or may be the cause of a fistulous communication with an air-passage.

(b) *Diffuse phlegmonous œsophagitis* is a rare condition, and may best be described as being a cellulitis of all the coats of this canal. Intense œdema is present, together with a turgid mucosa, which diminishes the lumen. The submucosa and muscular layers are filled with pus, which is also present in the peri-œsophageal tissue. It may track extensively in any direction, affecting all the organs of the thorax, as well as extending to the pharynx and the stomach.

Almost the only method of diagnosing this condition is by the symptoms and the character of the material regurgitated through the mouth, except in cases in which a foreign body is suspected. Neither œsophagoscopy nor catheterization should be carried out: such investigations are not only useless but very dangerous during the acute attack. Laryngoscopy, however, in the more severe forms of inflammation of the upper third of the œsophagus, often reveals a hyperæmic and œdematous condition of the hypopharynx, together with some œdema of the glottis.

DIAGNOSIS

SYMPTOMATOLOGY. A. Mild Œsophagitis.—The patient experiences an acute onset of pain accompanied by dysphagia. The odynphagia is severe, and located either along the spine or behind the sternum. Attempts to swallow increase it, and the large quantity of saliva produced is allowed either to dribble from the mouth or is regurgitated. The dysphagia is spasmodic and accompanied by the intense salivation which some observers believe is due to an œsophago-salivary reflex.

As this condition is frequently produced by a foreign body, œsophagoscopy is often undertaken. A general anæsthetic may sometimes be needed, in addition to the ordinary local anæsthetic, to overcome the spasm of the mouth of the canal, and the pathological conditions described are readily seen. A local area or areas of œdema form some opposition to the passage of the tube, and bleeding readily occurs. With the removal of the exciting cause improvement is rapid.

B. Ulcerative Œsophagitis.—The symptoms of the ulcerative type, being due, as a rule, to the swallowing of caustic or hot fluids, or to the firm impaction of a foreign body, are more intense and accompanied by considerable shock. As this passes off the patient improves for a time, but, later, severe pain is experienced, which is enormously increased when attempts are made to swallow. Frequent regurgitations of mucus, with particles of mucous membrane, occur, and the absorption of the so-called auto-toxins produces diarrhœa, accompanied by altered blood, and more or less collapse. Until the ulcerated

areas heal the localized spasm of the œsophageal wall is maintained and the dysphagia and odynphagia persist. Von Hacker, quoted by Bensaude, states that one-third of the patients swallowing caustics succumb to the immediate effects, such as shock, perforation of the œsophagus or stomach, hæmorrhage, or acute peri-œsophageal suppuration. Of the remaining two-thirds, one-half develop severe stenoses, of whom, again, half die.

C. Phlegmonous Œsophagitis.—The patient who develops a localized abscess experiences pain and dysphagia until the bursting of the abscess, which is usually induced by a vomit or a fit of coughing. He is then comparatively well, but must be kept under observation, lest a diverticulum or stricture should develop. If the abscess does not burst, the complications mentioned above may supervene.

The cases which develop a generalized phlegmonous œsophagitis usually do so some time after swallowing a sharp foreign body. The symptoms commence suddenly, usually being ushered in with a rigor. The pulse is rapid, the temperature high, the patient dyspnœic, and perspiration profuse; severe pain is present in the chest and back, and is increased on movement and on any attempt at swallowing. A swollen œdematous œsophagus may be palpated in the neck, and there may be regurgitation of muco-purulent secretions. The patient rapidly becomes collapsed and cyanosed, and death quickly supervenes.

TREATMENT

Little treatment is needed for the mild variety. The patient is kept on a fluid diet which consists chiefly of milk. Antispasmodics may be exhibited, and 1/100 to 1/75 grain of atropine may be given four or five times a day to diminish the saliva and to lessen the spasm. Belladonna, morphine, and papaverine are also useful drugs.

In the more severe cases the first line of treatment is directed against the causative factor, and the appropriate antidote administered. The poison may be diluted with a large amount of water. In caustic poisoning, emesis and the passage of gastric lavage-tubes are contra-indicated. Acids and alkalis are appropriately neutralized, bearing in mind that "carbolic acid" is an alkali and that its antidote is Epsom salts. Apart from this specific treatment, active symptomatic treatment must be adopted. This is directed towards combating the shock, the pain, and the dysphagia. The patient is put to bed and is kept warm; stimulants are given, the most useful being caffeine and camphor administered hypodermically. Morphine is used not only for the pain, but because, by relieving this, it causes an increase of blood pressure, and consequently markedly diminishes the shock. A watery solution of cocaine—in all $\frac{1}{2}$ to $\frac{3}{4}$ grain—may be given by the mouth if the patient is able to swallow. Ice is also helpful, provided deglutition is not too agonizing. Ice-packs may be applied over the neck, sternum, and spine.

In the suppurative varieties, recourse to the œsophagoscope is sometimes justifiable, provided the patient is able to stand it. The extreme seriousness

of the case should first be clearly pointed out to the patient or his friends, and it should be carefully explained that the œsophagoscope is only being used in an attempt to avoid a fatal termination. Otherwise the operation, and not the disease, is apt to be regarded as the cause of death.

By means of the œsophagoscope an abscess may be incised, and then improvement rapidly takes place.

The question of the performance of a gastrostomy must be considered in order that the patient's nutrition may be maintained. This, however, must not be done during the period of severe shock; a period of twenty-four to forty-eight hours should be allowed to elapse. After three or four weeks a persistence of the dysphagia indicates stricture-formation, and treatment for this should be commenced without delay, as described under the heading of Simple Strictures (pp. 153-159).

Acute œsophagitis may, however, be produced by a specific micro-organism, as, for example, in diphtheria and typhoid fever. It is always associated with signs of the causative disease elsewhere, and is not necessarily accompanied by œsophageal obstruction in the acute stages. The subject is therefore discussed fully under the heading of Simple Strictures (pp. 148-159).

C. PRESSURE FROM WITHOUT

PATHOLOGY

Acute inflammatory conditions arising in structures anatomically related to the œsophagus may occasionally give rise to acute œsophageal obstruction. This is produced by the local œdema, together with pain and reflex spasm of the œsophagus, and also occasionally by the actual pressure of a localized abscess or enlarged gland.

In the Neck.—Acute thyroiditis, with the formation of an extra-œsophageal cervical phlegmon, and also lymphatic adenitis, suppurative laryngitis, and an abscess arising from spinal caries, may cause acute or subacute œsophageal obstruction.

In the Thorax.—Mediastinitis arising from tracheo-bronchial glandular infection or empyema may have the same effect.

In the Abdomen.—Similarly, an abscess situated in the subphrenic region in contact with the œsophageal opening of the diaphragm may give rise to acute œsophageal obstruction.

DIAGNOSIS

The symptoms of any patient suffering from one of these conditions are usually those referable to an extra-œsophageal lesion, and have been present for a considerable time before any symptoms referable to swallowing have made their appearance; only when the disease is in an advanced stage does the œsophagus become affected. A careful physical examination of the

patient with the assistance of the Röntgen rays should render diagnosis a matter of no difficulty.

TREATMENT

The treatment of these conditions should follow well-established surgical lines, and need not be specially detailed in this work.

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CHAPTER VII

CARDIOSPASM AND NEUROPATHIC AFFECTIONS OF THE ŒSOPHAGUS

Introduction.—Any constriction of the œsophageal canal, whether of a transient or of a permanent nature, which produces a condition of relative or absolute dysphagia, and is caused by a spasm of either a localized part, or the whole, of the œsophageal wall, is referred to as a neuropathic affection of the œsophagus.

This type of lesion, in which no organic basis can be found, is sometimes termed “œsophagismus”. Almost all varieties of œsophagismus are associated with obstruction to the passage of ingesta into the stomach, and therefore come within the scope of this work.

The description of these phenomena falls naturally into three divisions :

- (1) So-called spasm at the upper end of the œsophagus.
- (2) So-called spasm at the lower end of the œsophagus.
- (3) So-called spasm occurring in the course of the œsophagus.

GENERAL CONSIDERATIONS

First of all in considering this matter I wish again to point out the manner in which the upper and lower ends of the œsophagus are normally in a state of tonic contraction. At the upper end it is the crico-pharyngeus muscle which maintains this degree of tone. At the lower end contraction occurs not at the anatomical cardia, that is to say, not at the point where the œsophagus joins the stomach, but from one to two inches above this level ; that is, at about the level where the œsophagus passes through the hiatus œsophageus of the diaphragm. Here the circular fibres of the œsophagus form the cardiac sphincter, and this is about one inch in length (see Fig. 58).

The normal closure of the œsophagus at this level is considered by Chevalier Jackson actually to be effected by tonicity of the fibres of the diaphragm which encircle the œsophagus, and he refers to cardiospasm as “hiatal œsophagismus”. But, as Keith pointed out many years ago, and still maintains, a true œsophageal sphincter exists in the wall of the œsophagus at or about the level of the hiatus œsophageus of the diaphragm, but entirely independent of it. This area of sphincteric tissue is more easily demonstrable in a specially

prepared cadaver: the subject should be given an intra-arterial injection of one pint of formalin in eight pints of water within a few hours after death; this will be found to cause the sphincters in the alimentary canal to remain closed.

The physiology of normal deglutition must again be called to mind. The act of swallowing is performed mainly under the influence of the parasympathetic portion of the autonomic nervous system. Stimulation of this produces effects directly the reverse of those resulting from stimulation of the sympathetic portion. The physiological processes which take place on

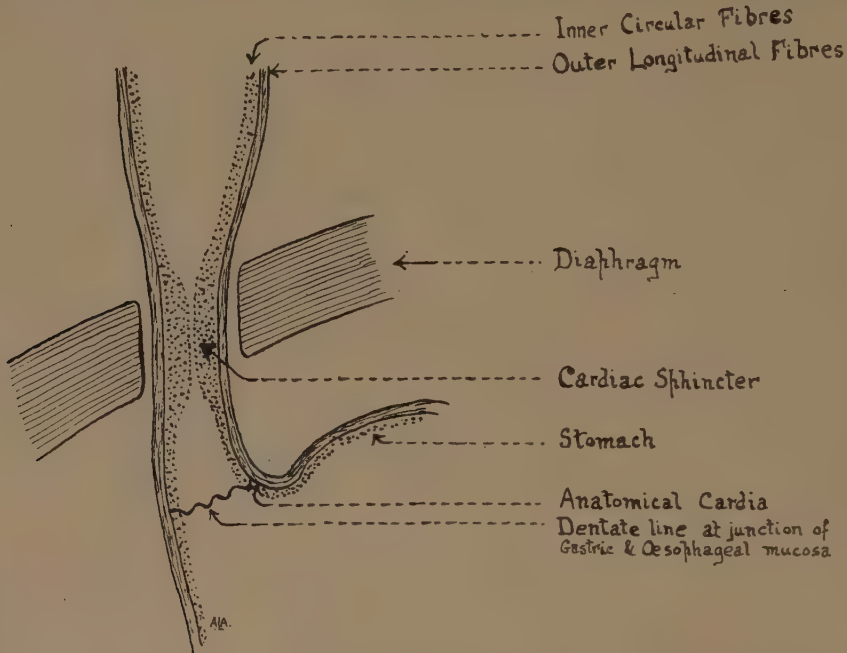


FIG. 59.—Diagram of relations of cesophagus, stomach, and diaphragm, showing cardiac sphincter.

sympathetic stimulation are a diminished flow of saliva, an inhibition of peristalsis, and a spasmodic contraction of the upper and lower sphincters of the cesophagus. Throughout the animal world they occur during muscular exercise, especially during the search for food or in mortal combat, and in human beings at times of mental concentration, especially when accompanied by worry or grief.

The parasympathetic nervous system, on the other hand, should come into play at a time of both physical and mental repose, when the function of the sympathetic portion is relatively in abeyance. The effects on deglutition of stimulation of the parasympathetic portion are an increased output of saliva rich in ferments, peristalsis of the cesophagus, and relaxation of the sphincters. Relaxation is brought about, first, by the direct action of the

longitudinal fibres, and, secondly, by a diminution of the tone of the sphincters—an inhibitory reflex caused by the act of swallowing.

It follows, therefore, that this reflex arc may be disturbed either on the side of the parasympathetic system, or, more commonly, on its sympathetic portion, or by a central, cerebral, or psychic effect acting upon either or both. When dealing with such a complicated mechanism it is difficult not only to distinguish which one of these three portions of the reflex arc is at fault, but also to determine at what level, or in what manner, this disturbance has occurred.

The crico-pharyngeal sphincter is much more powerful than the cardiac sphincter, and is always closed except when deglutition or ejection is actually occurring. The cardiac sphincter, on the other hand, is much more feeble, and opens and closes throughout gastric digestion (see remarks on the acid control of the cardiac sphincter, p. 18).

Secondly, any psychical stimulus upon the sympathetic portion of the autonomic nervous system has a greater effect upon the upper than upon the lower sphincter of the œsophagus, for two reasons:

(1) Because the crico-pharyngeus muscle is much more powerful than the cardiac sphincter.

(2) Because the lower pharyngeal and upper œsophageal region is more plentifully supplied with sensory nerve fibres than is the lower third of the gullet, and therefore irritation more rapidly forms a vicious circle at the upper end. Hence the common sensation of a “lump in the throat” on any severe psychic stimulus.

Spasm.—What is meant by the term spasm? There are two distinct portions of the alimentary canal where spasm is considered to occur: (1) at the sites of sphincters, *e.g.* crico-pharyngeus muscle, cardiac sphincter, pylorus, ileo-cæcal valve, etc.; (2) at places in the alimentary canal where it is known that sphincters do not exist, *e.g.* in the middle of the œsophagus, in the middle of the stomach at the level of a gastric ulcer, etc.

My view of sphincteric tissue is that it is an area where normal or excessive tone can be maintained indefinitely without the muscle at this level becoming hypertrophied (or, if it does do so, only to a very slight degree), and it is the musculature proximal to it which hypertrophies if the sphincter is in a hypertonic state, *i.e.* a state of spasm.

To the best of my knowledge and belief, spasm occurring even in non-sphincteric portions of the alimentary tract is not followed by any local hypertrophy.

I would therefore define spasm when used with reference to either the upper or lower sphincters of the œsophagus as an increase in the normal tonicity of these muscles and would not expect any local hypertrophy to be present. When the comparatively powerful crico-pharyngeus muscle is spasmodic, considerable force has to be used to overcome it. The cardiac sphincter, on the other hand, is never powerfully contracted, and therefore even hypertonicity does not cause a very tight closure of the œsophagus at this level.

Hypertonicity or spasm occurring in the alimentary canal produces a local passive congestion which ultimately results in fibrous induration. Evidence of such induration as a sequel to passive congestion is well exemplified in the case of the indurated zone in the neighbourhood of a varicose ulcer of the leg. In the alimentary canal the minute capillary venous plexus situated in the submucous tissue becomes the site of passive congestion, with the result that a deposit of fibrous tissue takes place at this level. The fibrous deposit takes the form of a circular band varying in thickness and density. This has been demonstrated very clearly by Miles with reference to the anal canal, where not only does spasm and consequent passive congestion occur, but large varicose veins (internal piles) are also frequently met with. Very often, however, it is present in the complete absence of any hæmorrhoids. This fibrous deposit, which I have often noted at the level of the crico-pharyngeus muscle, limits the expansibility of the gullet and gives rise to painless dysphagia which is or may have been for many months a precursor to a hypopharyngeal neoplasm. A similar condition at the anus, the pecten band, is a frequent precursor to carcinoma of the rectum. That it occurs at the level of the cardiac sphincter in cases of so-called cardiospasm is almost certain (see below).

Accessory Action of the Diaphragm.—It seems probable that the diaphragm exerts a certain amount of constricting action upon the œsophagus where the latter passes through it. Whether this occurs in states of rest and repose is not known, but that it takes place under muscular exertion and with dyspnoea would seem most probable. The effect of this would be to prevent the regurgitation of food from the stomach to the œsophagus at a time when the fullest thoracic capacity is required for cardiac and pulmonary functions. There is no definite evidence to show that abnormal states, *e.g.* cardiospasm, are accompanied by spasm of the fibres of the diaphragm which encircle the gullet. (See discussion below.)

(1) SO-CALLED SPASM AT THE UPPER END OF THE ŒSOPHAGUS

A type of dysphagia due to a relative closure of the œsophagus at the level of the crico-pharyngeal sphincter, associated with anæmia and occasionally splenomegaly, has been recognized for a number of years. Bronner, in 1913, noted dysphagia after the impaction of a foreign body at the mouth of the gullet in cases which suggest that stenosis was present before the impaction. Dan Mackenzie, in 1918, reported two cases of post-cricoid spasmodic stricture. The condition was more fully described in 1919 by Brown Kelly and D. R. Paterson, and attention has also been called to it by Chevalier Jackson, Plummer and Vinson, and Mason Jones and Owen.

The condition is regarded as being due to a spasm of the crico-pharyngeus muscle and has been considered to be due to a disturbance of balance between Auerbach's plexus (the motor nerves) and Meissner's plexus (the sensory nerves). Undue irritation may lead to abnormal local hypertonicity or spasm. Chevalier

Jackson considers that once this spasm is established a nerve-cell habit is formed, and therefore the spasm recurs and becomes continuous. In these cases the tongue is smooth, atrophic, devoid of papillæ, and has local areas of superficial glossitis. The areas of glossitis are thin and small, quite unlike the dense chronic superficial glossitis of syphilis. The mucous membrane of the pharynx is thin and atrophic.

Plummer and Vinson consider the dysphagia to be functional, and call attention to the anæmia and splenomegaly resulting from the paucity of the patient's diet. Only twelve of their sixty-nine cases had splenomegaly.

Hurst considers the condition to be primarily due to a streptococcal infection, as the *S. longus* is often obtained from the throat, but this view in my opinion is irrelevant.

With regard to the blood picture, there is a definite reduction in hæmoglobin, approximately 60 per cent Hb being frequently found; but it may fall as low as 30 per cent. The red cells vary from two to five million, the white cells from five thousand to seven thousand per c.mm. Cameron states that the only constant blood change is a reduction in hæmoglobin.

My remarks above relating to spasm will, I think, explain the pathology of the condition. Concisely, they are as follows: A psychical stimulus or a local pharyngitis produces a reflex stimulation of the sympathetic nerves, causing a hypertonicity (spasm) of the crico-pharyngeus muscle. This is followed by (1) passive congestion at the mouth of the œsophagus with local round-celled infiltration and the development of a whipcord-like ring (named the "crico-pharyngeal band"—cf. Miles' "pecten band" in the anal canal). With the passage of months and years this band becomes more and more dense and prevents the proper relaxation of the sphincter; (2) the pharyngeal mucous membrane is the site of mild inflammatory and later atrophic changes, which are prone to become the seat of malignant disease.

DIAGNOSIS AND TREATMENT

Radioscopy will reveal a delay in the passage of opaque food from the pharynx to the œsophagus. It should be followed by œsophagoscopy, and in an uncomplicated case, no malignancy being found, the lumen of the lower pharynx is seen to be puckered and of only three or four millimetres' diameter. Under direct vision a bougie passes with difficulty and the stenosed area may be seen to split. The initial bougie should be followed by larger bougies until eventually the whole œsophagoscope enters the lumen of the œsophagus. Immediately the patient attempts to swallow the dysphagia is found to have disappeared, and the general health and anæmia improve rapidly. Occasionally a few further dilatations are necessary, but as a rule a complete cure results from the first. I have had a specially large bougie made for dealing with this type of case (see Figs. 33 and 34).

(2) SO-CALLED SPASM AT THE LOWER END OF THE ŒSOPHAGUS

Under this heading must be included the large variety of lesions unassociated with any organic obstruction or organic lesion of the wall of the gullet or compression by a neighbouring tumour. Many names have been given to this condition, *e.g.* idiopathic dilatation, primary and essential dilatation, diffuse dilatation, neuropathic dilatation, functional hiatal stenosis, mega-œsophagus, preventriculosis, œsophagectasia, phrenospasm, achalasia, and cardiospasm.

Historical.—Dilatations of the œsophagus were first recorded by Purton in 1821, and the first detailed description was given by Rokitsansky in 1840. Zenker and Ziemssen in 1877 devised means for recognizing the condition in the living, as previously, although suspected during life, it was never verified until the post-mortem examination was made. The precise study of this type of lesion was first carried out by Rosenheim in 1895 by means of œsophagoscopy, and by Rumpel, using radioscopy, in 1897. The condition, formerly considered extremely rare, is now known to be relatively frequent.

PATHOLOGY

ÆTIOLOGY. I. Pathogenesis.—The predisposing factor in many such cases is the neurotic tendency of the patient, who frequently exhibits associated neurasthenic conditions, especially abdominal visceroptosis and globus hystericus. This, however, is not invariable. Certain actual exciting causes are to be noted: the chief of these is a violent emotion, especially grief. The Great War is accountable for a large number of cases of this condition seen in recent years. Another direct cause is injury, either by a foreign body or by the passage of an instrument. Chronic irritation produced by pyogenic micro-organisms, arising primarily from infected teeth, has been responsible in many cases. In a large proportion of cases, however, no ætiological factor can be discovered.

THEORIES OF CAUSATION

The theory of a congenital origin has been especially emphasized by Bard of Strassburg, who maintains that a dilatation may be produced in the course of development as an abnormal growth of the organ. This may therefore be compared with congenital enlargements of other muscular tubes in the body, especially the colon, and occasionally the ureter, as is suggested by Bard's term "mega-œsophagus". The great objection to this theory alone is that no explanation is forthcoming of the following points:

- (1) The symptoms, especially the dysphagia.
- (2) The latency of the symptoms for from twenty to forty years.
- (3) The paroxysmal character of these symptoms.

Certain types of dilatation are undoubtedly due to incomplete congenital

stenosis in the region of the cardia, and may remain latent until a superimposed stimulus gives rise to the spasm which causes a more marked œsophageal obstruction.

Theories of Acquired Origin.—I wish it to be clearly understood from the outset that there is a great deal of difference between the anatomical cardia on the one hand and the cardiac sphincter on the other. The anatomical cardia is the place where the œsophagus joins the stomach and is shown on the interior of the two viscera by a dentate line where the pink mucous membrane of the œsophagus becomes the red mucosa of the stomach. The cardiac sphincter is formed by specialized fibres of the circular muscle-coat, and is situated from one to two inches above the anatomical cardia.

Phrenospasm.—That the true cause of the obstruction at the lower end of the œsophagus is a spasm of the muscular fibres of the diaphragm which encircle the œsophagus is the theory put forward by Jackson, Sauerbruch, and von Hacker. My objection to this theory is that whilst it is true that the fibres of the diaphragm which surround the œsophagus are somewhat specialized, there is no evidence that they have any special nerve supply; secondly, the reflex which inhibits respiration when deglutition commences, and which is similar in character to the inhibition of respiration caused by the application of cold water to the face, takes place *via* the respiratory centre and the central nervous system; the lower end of the œsophagus, on the other hand, has a specialized sphincter, and the nervous control of this is maintained by the autonomic nervous system, which is known to be more responsive to psychical influences than is the central nervous system.

Gastrosperm.—Fleiner maintains that in so-called cardiospasm the anatomical cardia is permeable (this is true), but that it is actually the muscle fibres of the stomach in the region of the cardia which are in a state of spasm. He bases his assumption on the fact that a radiogram sometimes shows a prolongation of the terminal portion of the œsophagus towards the left. This appearance is easily explained by remembering that the parallel folds of mucous membrane at the upper extremity of the lesser curvature of the stomach easily retain small fragments of the opaque emulsion, and can thus give rise to this appearance (Hirsch, Huber, and Bensaude and Rivet).

Theory of Œsophageal Atony.—Mackenzie and Rosenheim consider that a primary—either congenital or acquired—atony of the œsophageal musculature occurs in a number of œsophageal dilatations, thus placing the condition of the cardia as a purely secondary phenomenon, called into play and maintained by the irritative lesions occurring in the œsophagus.

Starck states that no case of purely atonic dilatation has yet been seen. As is well known, muscular hypertrophy is almost always present in the œsophageal wall.

Theories of Defective Functioning at the Cardiac Sphincter.—Kraus states that dilatation may occur from so-called cardiospasm, with simultaneous atony due to a degenerative or paralytic affection of the vagus or of some of its branches. It is quite possible that the reflex arc may be

disturbed by atrophic lesions occurring in the vagi such as Kraus found in his cases.

Thiéding holds that the dilatation of the œsophagus is not an isolated disease of the cardia and œsophagus *per se*, but is due to a spasm dependent upon a local or a general condition. As examples of local affections he mentions trauma, neuritis, and compression by a tumour. The general conditions cited include emotion, endocrine disturbance, infections and intoxications. Any such condition may give rise to a disturbance of the function of the autonomic nervous system and thus interrupt the normal reflexes which regulate the combined mechanism of the œsophageal musculature and of the entrance of food into the stomach.

Zaaijer considered that the non-opening of the cardia was due not to an inherent spasm, but to failure of the function of the longitudinal muscle fibres to open the lumen of the œsophagus at this level, and hence applied the term "cardioparalysis".

This failure of the co-ordinating mechanism has been named by Hurst "achalasia of the cardia". This term explains only part of the truth, as I shall show later. It has been shown experimentally by Langley, working with cats, that the longitudinal fibres may be paralysed by division of the vagi. By feeding, after this experiment, Cannon has produced dilatation of the œsophagus with muscular hypertrophy, *i.e.* a condition similar to that found in human cardiospasm. Stokes and Rake have demonstrated inflammatory and degenerative changes in the lower end of the œsophagus, particularly involving Auerbach's plexus in the neighbourhood of the cardiac sphincter, and also that this region had been infiltrated by fibrous tissue.

In order to trace the neurological process involved which causes permanent spasm of the cardiac sphincter, Wilms has supposed that some particular action is exerted by means of the sympathetic nervous system. This, which he attributes to spasmophilia, he believes occurs not only at the cardia, but at the pylorus, at the recto-sigmoidal junction, and at the neck of the bladder, and his term is only to be looked upon as a suggested explanation of a defective functioning at the cardiac sphincter.

The term "hypertonia" is used by Mathieu and Sencert, who regard the condition as being a hypertonic closure of the circular fibres at the cardia, due to the fact that the normal inhibitory stimulus has failed to reach them. Once this inco-ordination has occurred, the successive movements of deglutition, which normally do not take place until the bolus has passed the cardiac opening, are thrown out of action.

Conclusions.—The conditions of dilatation of the œsophagus, hypertrophy, and atony, associated with spasm of the cardiac sphincter, are true neuropathic manifestations, which may exist singly or combined, or may be consecutive in their onset. The autonomic centres acting with the vagus in a parasympathetic manner, and *via* the sympathetic nerves in an opposite manner, control the function of the lower part of the œsophagus. Any increase of stimuli passing *via* the vagus may therefore cause intermittent spasms in the

main portion of the œsophagus, whilst predominance of sympathetic effect results in a contraction of the cardiac sphincter. Should the vagal influence be completely abolished, atony of the œsophagus results.

By cardiospasm, therefore, I mean cardiac-sphincter-spasm. This theory of cardiospasm is founded upon a great number of œsophagosopic and post-mortem examinations, which have shown a dilatation of the œsophagus with a spasmodic stricture in the region of the sphincter. The term "idiopathic", therefore, should not be used when referring to this type of dilatation of the œsophagus, but the primary cause should first be recognized. Spasm of the cardiac sphincter, occurring in a previously normal œsophagus, is followed by an attempt on the part of the œsophagus to overcome the obstruction. The wall of the organ therefore hypertrophies, and, later, dilatation occurs. This leads to stagnation of food and consequent œsophagitis, which causes a secondary spasm of the sphincter. Thus a vicious circle is formed and the intermittent symptoms eventually become persistent. Later, when the musculature of the œsophagus becomes atonic, the normal physiological tone of the cardiac sphincter is no longer inhibited, as should occur with the peristaltic wave of the œsophagus on deglutition; under these circumstances, therefore, a second or duplex vicious circle is established.

Lastly, I would again call attention to my remarks above on spasm (p. 73), with especial reference to the observation that hypertrophy of the muscle would not be expected. Even if hypertrophy does occur, degenerative changes in the muscular coats probably cause the muscle, which at one time was hypertrophied, to appear of normal or diminished thickness by the time the post-mortem examination is reached. It has already been shown that fibrosis occurs in the wall of the œsophagus at the level of the sphincter (Stokes and Rake), and this I have compared to the pecten band at the anus. The fibrosis is due to passive congestion, and as soon as this "cardiac band" is established, no further active spasm of the sphincter is necessary in order to maintain stenosis of the canal.

II. Age.—Symptoms of this condition rarely arise before the age of 20, and seldom after 40. Cases have, however, been noted in childhood.

III. Sex.—The condition is more common in females than in males in the proportion of about 2 to 1. In my experience, females are usually affected at a younger age than males.

IV. Morbid Anatomy.—In *shape* the œsophagus is usually fusiform. It may, however, retain its cylindrical form, and not become fusiform until the disease has been established for some time, finally dilating still further in its lower portion to become pear- or gourd-shaped.

Length.—In the earlier stages, and sometimes throughout the whole course of the disease, the length is not increased, but after some years an increase in length frequently occurs; the œsophagus then shows the presence of markedly exaggerated curves.

Calibre.—This, again, is variable, the largest recorded case being 30 cms. in circumference.

Capacity.—The normal capacity of the œsophagus is about 100 c.cms.; as the dilatation progresses the capacity obviously increases until fifteen or even twenty times the original volume may be held.

Wall.—All the coats of the œsophagus are involved in the general dilatation. On section, marked hypertrophy, especially of the muscle, is apparent. It may be four or five times the normal thickness; whilst all layers are hypertrophied the circular muscle fibres are most affected, and are increased both in number and in size.

On account of the fact that the cardiac sphincter is situated at or about the œsophageal opening in the diaphragm, the dilatation does not commence at the cardia, but some two inches above it; that is, at about the level of the upper surface of the diaphragm.

No lesion is found at the cardia. There is neither erosion nor ulcer, nor any organic stenosis. The cardiac sphincter, on the other hand, is firmly contracted, and some force is required to insert a bougie or œsophagoscope through it, whether passed perorally or by the retrograde route.

The Mucous Membrane.—This shows a variety of lesions, dependent upon the chronicity of the disease. It is often congested, duller than usual, and may be actually œdematous, usually in patches, with some local induration. Superficial erosions are apt to occur, which may later become actual ulcers and penetrate through the muscular coat, even causing a peri-œsophageal abscess.

DIAGNOSIS

Symptomatology.—The degree of difficulty in swallowing is especially variable in neuropathic affections of the œsophagus, and is found to bear no relation to the degree of dilatation. It is rare for prodromal symptoms to be present, as the dysphagia itself is frequently only slight in degree and transitory in nature. This is accompanied by a sensation of discomfort in the centre of the chest, and the act of swallowing becomes conscious as opposed to the normal subconscious, and large mouthfuls appear to stop below the lower half of the sternum.

It sometimes happens that the œsophageal symptoms commence suddenly, perhaps in the middle of a meal. This is especially true in neurotic female patients, and often closely follows a violent emotion. Starck is of opinion that, in this type of case, the disease has been latent for some considerable time before the supposed onset.

When the sensation of the stoppage of food occurs, the patient experiences a desire to force the swallowed food into the stomach. This he endeavours to do, either by drinking large quantities of water, or by standing up, and sometimes shaking himself, or he may press upon the thorax, or swallow gulps of air in a forcible manner, or take long deep breaths. Sitting upright, or even standing, while eating, becomes necessary, and food cannot be taken when lying down.

When the period of onset is long and gradual, adaptation takes place, and the act of deglutition again becomes subconscious, until, as invariably happens,

a relatively sudden increase in the dysphagia occurs. The trouble now becomes definitely remittent in character, and may eventually be permanently severe. At the times when the dysphagia is more marked the patient swallows a smaller bolus of food or may take no solids at all, but only large quantities of fluid, often together with a considerable quantity of air. After a meal there is always a sensation of weight or discomfort, usually referred to the epigastric region. Acute pain may be experienced, which may be of a colicky nature, and these sensations do not disappear until the food has passed into the stomach. The patient may be able both to feel and to hear this happen. On account of the fact that so many of the sufferers are obviously of a neurotic type and complain of a feeling of a lump in the throat, and admit that the symptoms are worse when they have an attack of "nerves", the condition is apt to be labelled hysteria for a long time before careful investigation is made to ascertain the true nature of the disease present.

As the condition becomes more advanced, regurgitation takes place with increasing frequency, and also in increasing amounts. In the relatively early stages only a little of the recently taken food is returned. Later, a larger amount of stale and foul-smelling food makes its appearance, sometimes measuring over a pint. This regurgitation, or so-called "œsophageal vomiting", may be accompanied by nausea and a certain amount of effort; but at a still later stage the "vomit" is effortless and painless, and the contents of the œsophagus appear to pour from the mouth like water from a jug. This may occur during sleep and wake the patient with a violent fit of coughing, due to the entrance of œsophageal contents into the respiratory tract. The coughing is followed by a further regurgitation, and the patient soon learns to sleep propped up by several pillows. When regurgitation has taken place, the symptoms due to the distended and loaded œsophagus disappear, although after many hours' fasting they may return to a slight extent, owing to the accumulation of saliva and mucus, which may be regurgitated on waking in the morning.

As in all types of œsophageal obstruction, increased salivation occurs; and, if the regurgitation is not forcible, rumination may actually take place, the patient then complaining of a constant bad taste in the mouth, and the breath being found to be fœtid.

Hiccough has been noted by many observers in a large proportion of cases; sometimes being an earlier symptom than dysphagia and occurring in the course of a meal.

Symptoms due to Pressure by the Distended Œsophagus.—Depending on the amount of œsophageal distension, various crises may occur. Pressure upon the heart may give rise to cardiac embarrassment, accompanied by palpitations and faintness. Pressure upon the lungs and bronchi may give rise to a sense of oppression and dyspnoea, simulating an asthmatic attack. Sudden stretching of the pleura or nerves may cause pain, which radiates along the costal margin and upwards to the shoulders.

Associated Hysterical Symptoms.—In female patients especially, various

neuroses frequently accompany cardiospasm. Such patients tend to be highly-strung and emotional. The palms of the hands and the soles of the feet are moist, dermatographia may be demonstrable, and visceroptosis is often present. Other spasmodic conditions indicative of increased tonicity of the sympathetic portion of the autonomic nervous system, such as mydriasis, or a condition simulating mild Graves' disease, may be present.

General Condition.—The patient's general condition is satisfactory for a considerable time, and the appetite frequently remains good, although the disease may last for thirty or more years. The remissions may extend over many years, during which time the patient is free from symptoms; but sooner or later a change takes place and cachexia begins to develop. Even if the symptoms disappear for a number of years the dilatation of the œsophagus persists, and the patient must be instructed how best to avoid a recurrence of symptoms of the latent disease.

Symptomatology of Complications.—The symptoms of the complications, which are described in the section dealing with the pathology of the condition, are too obvious to demand any detailed attention. Perforation of the œsophagus causes a violent mediastinitis and rapid death. Compression of the trachea also may prove fatal, or predispose to pneumonic affections. Superficial ulceration of the gullet may cause a fatal hæmatemesis. The effects of toxic absorption may be obvious on examination, whilst sudden exacerbation of symptoms in a case of long-standing dysphagia must suggest the possibility of superimposed malignant disease.

Clinical Examination.—Although the symptomatology may, in a large number of cases, point clearly to the diagnosis, this must always be confirmed by a careful and methodical examination of the patient. Few physical signs may be present, but a large dilated œsophagus filled with food or fluid may give a definite zone of dullness on percussion in the paravertebral region.

Auscultation reveals a modification of the normal sounds of deglutition, and the sound of the passage of fluids through the cardia may be lost, delayed, or modified.

As in all suspected intrathoracic lesions, the heart and lungs must be systematically examined; the neck must be palpated for glands, and examination made for signs of pressure on the nerves to the pupils and larynx.

Radioscopy.—After the general examination of the patient and the performance of a laryngoscopy, the next method of investigation should be by means of the fluorescent screen. This, as in all radioscopic examinations of the œsophagus, should be done with the patient in the oblique or lateral position, and not only in the antero-posterior plane. The opaque drink should be thick and creamy, and should be watched as it is swallowed so that the effects of the movements of the wall of the œsophagus may be observed. In a typical case of "cardiospasm" the opaque fluid has the outlines of a large swelling filling the posterior mediastinum, and descending to the level of the diaphragm. The principal features are its breadth, its length, and the smooth rounded or conical shape of the lower extremity. The breadth is usually much larger

than that of the shadow seen above a malignant growth, and may be either quite regular or larger about the middle or at the lower end. There may be, therefore, three different appearances, viz. cylindrical, spindle-shaped, and pear-shaped. If the dilated œsophagus is elongated, the shadow is seen to have curves, the lower portion appearing to lie somewhat transversely above the diaphragm. (See Fig. 62). The lower extremity has a clearly demarcated outline, which usually tapers somewhat at the lowest point, where it passes below the level of the cupola of the diaphragm, but not below the level of the œsophageal opening in the diaphragm, except when small fragments of the opaque material are retained at the upper extremity of the lesser curvature of the stomach (see p. 77). The peristaltic and anti-peristaltic movements of the œsophageal wall may be clearly seen, except when atony has supervened, in which case the shadow appears immobile.

An exact diagnosis by means of radioscopy is not always easy, and it is sometimes advisable to administer an antispasmodic injection in order to attempt to cause the cardiac sphincter to relax. For this purpose atropine and papaverine may be used. The spasm may then be overcome and the accumulated material in the œsophagus pass into the stomach. This

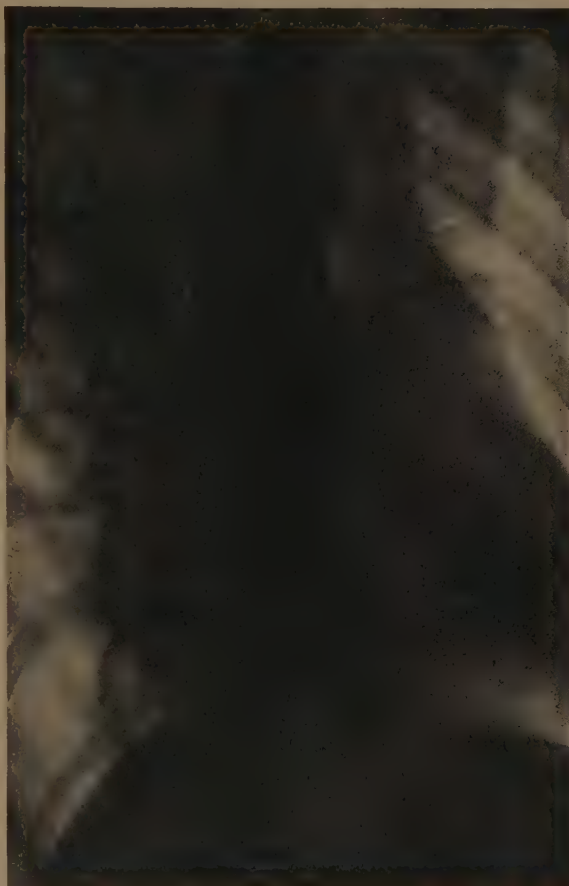


FIG. 60.—Radiogram of a case of cardiospasm.

definitely proves that the condition is not an organic stricture. The converse, however, does not hold true, as the injections sometimes have no effect in cases of spasm.

Œsophagoscopy.—Direct inspection of the œsophagus is the most important of all methods of investigation, for two reasons : (1) it is only by this means that an absolutely accurate diagnosis can be made ; (2) even if an accurate diagnosis has previously been made with regard to the dilatation of the œsophagus, the presence of an organic lesion at the cardia, or throughout the

course of the œsophagus, must also be sought for. Œsophagoscopy is carried out as already described (p. 41). When dealing with this type of case the dilated œsophagus should first be cleansed with warm water, and the examination made only when it is empty; it is often advisable to lower the head-end of the table a little earlier than in the ordinary examination.

Morphine and atropine may be used to diminish the amount of secretion. Once the œsophagoscope has passed the cricoid, the ease with which it may be moved about in all directions is soon noticeable.

The appearances previously described under the heading of Pathology are now observed: the mucosa is generally congested, and the vessels are clearly seen, especially towards the cardia, where they are dilated and form arborizations. If much œsophagitis is present, superficial erosions are found, which bleed easily and give a discoloured appearance. Even in large dilatations the mucosa is in transverse folds, and not until an extreme degree is reached do the folds disappear. The normal respiratory and cardiac movements of the wall of the œsophagus are not observed in any but mild dilatations. A special study must be made at the level of the cardiac sphincter. (See Plate I. g.) Normally, at this level there is the appearance of a funnel which moves with respiratory movements, and gas-bubbles



FIG. 61.—Radiogram of a case of cardiospasm with great dilatation of œsophagus.

are seen to pass through it from the stomach from time to time. When in a state of spasm the orifice is very minute, the funnel appears deeper, with well-marked longitudinal folds—the so-called “rosette” appearance—no movement occurs on respiration, and little or no gas or mucus makes its appearance. If the examiner now makes an attempt to pass the œsophagoscope tube further, the contraction appears to increase, and the patient complains of pain. On applying steady pressure with the end of the tube upon the

cardiac sphincter, this may usually be made to relax, and the œsophagoscope then enters the stomach. Occasionally the rosette appearance is absent and the opening appears as a narrow fissure.

The range of movement of the lower end of the tube in the lumen of the gullet gives an approximate idea of its shape and dimensions.

Catheterization.—This method of investigation is unnecessary and should never be used. If employed at all the conclusions arrived at are apt to be erroneous, and, moreover, the passage of a sound is by no means devoid of danger.



FIG. 62.—Radiogram of a case of cardiospasm, showing marked dilatation and tortuosity of œsophagus—antero-posterior view.



FIG. 63.—Same case as Fig. 62—oblique view.

Those who carry out catheterization use an olive-tipped sound which, if the cardia is situated at the lowest part of the œsophagus, meets with a certain amount of resistance. Steady and sustained pressure can usually overcome this, and then the sound gives the impression of being firmly gripped by a tense sphincter.

If, however, the lower end of the œsophagus is flask-shaped or its dilatation is irregular, giving rise to a lateral cul-de-sac, the œsophageal lumen cannot be found; in such a case, if a firm sound is used and the force employed is not gentle, perforation may take place. The only really safe method of catheterization is by using Plummer's silk-thread guide, which, however, frequently fails to pass into the stomach.

If a hollow catheter is used, the contents of the dilated œsophagus appear at its upper opening, and consist of almost unaltered food, together with a large amount of mucus. In long-standing cases a little organic acid may be present, entirely due to lactic or fatty acids, but no trace of gastric digestion is found. Kraus points out that pepsin and rennin-ferment are absent, though sugar may result from the action of saliva upon starch, and fungi may be present.

Differential Diagnosis.—The differential diagnosis of cardiospasm is not as difficult as was formerly supposed, provided that the condition is borne in mind and a careful routine examination made of all cases.

TREATMENT

MEDICAL TREATMENT. Hygienic.—The patient's general health must receive careful attention, and all forms of mental stress or strain should be carefully avoided. Any detail in the domestic, professional, or business life of the patient which may appear, after questioning, to have been the underlying factor in the ætiology of the disease should be eliminated as far as possible.

Psychotherapy and hypnosis have been used with varying success; they are most likely to produce good results in early cases occurring in young neurotic females.

Dietetic.—The patient's experience gives a useful guide to the food substances which are best avoided: amongst these are alcohol and spices. It frequently happens that solids pass more readily than fluids, and it is often advisable for a meal to be commenced with oily substances in order that the inflamed wall of the œsophagus may be covered with an emollient, which thus tends to prevent injury by the subsequent solid particles and consequent excitation of the spasm. The patient is well advised to take small quantities of food at frequent intervals.

Medicinal.—*Nux vomica* should be strictly avoided, but antispasmodics, *e.g.* bromides, atropine, papaverine, morphine, codeine, alone or combined with valerian, may be given. They are not of any striking value, however.

SURGICAL TREATMENT

A. Palliative.

B. Curative.

(1) Instrumentation and Dilatation.

(2) Radical Operation.

A. Palliative.—When the inanition which develops in these cases begins to be a marked feature, gastrostomy is required, but before this is done numerous other attempts at cure should have been given a thorough trial. It might be thought that after the gastrostomy had been functioning for some time the lesion of the œsophagus would improve. This, however, is rarely the case.

B. Curative. (1) *Instrumentation and Dilatation.*—The method most commonly employed is by means of various instruments, all of which aim at dilating the cardia. Dilatation may be performed under general or local anæsthesia, or preferably with no anæsthetic at all. It is best performed by means of direct œsophagoscopy, and, whilst usually carried out from above, it may sometimes have to be done by retrograde œsophagoscopy after an



FIG. 64.—Howarth's cardi dilator.

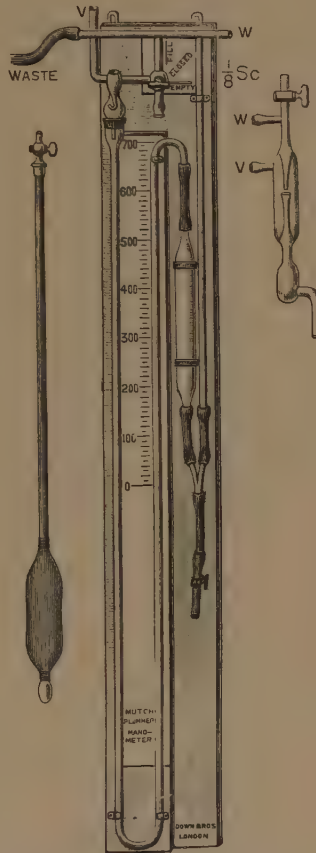


FIG. 65.—Mutch-Plummer manometer.

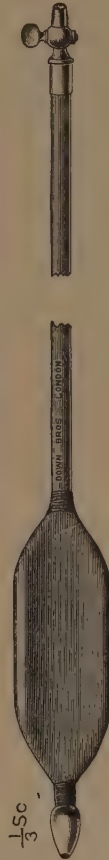


FIG. 66.—Mutch-Plummer bag.

opening has been made into the stomach. It must always be borne in mind that a rigid sound in the œsophagus, whether handled by doctor or patient, is an instrument of extreme danger, and should never be used except under direct œsophagoscopic vision.

The methods of dilatation may be described as :

(a) Gradual dilatation by means of graduated sounds similar to Hegar's dilators. This is found not to give such good results as :

(b) Sudden dilatation, *e.g.* by means of Howarth's cardi dilator (Fig. 64) ; or

(c) The use of rubber bags, or soft, easily dilatable rubber catheters which are distended with water, with mercury, or with air.

Hurst uses rubber tubes 31 inches long, varying in diameter from $\frac{3}{8}$ ths to $\frac{1}{2}$ ths inch, each containing 1 lb. 5 oz. of mercury. On the first occasion the passage of the bougie is observed by the fluorescent screen, and a mark made upon it at the level of the incisor teeth when its lower two inches are in the stomach. Successively larger tubes are passed at the same sitting. Subsequent treatments depend upon the patient's symptoms, but if these have been of long standing the patient is taught to pass the largest bougie on himself before each meal. At the first few sittings the bougie should be retained in position for a quarter of an hour; later the time of retention may be reduced and also the frequency with which the bougie is passed.

The Mutch-Plummer apparatus (Fig. 65) effects dilatation by means of a specially-shaped bag (Fig. 66), which is distended with water, either from a water-main or from a bottle in which water is under pressure from a hand-pump. Its disadvantages are that it cannot be used by the patient upon himself, and that it has occasionally proved fatal by splitting the œsophagus.

Early cases may be cured by means of one sudden dilatation, but long-standing cases are notable for their frequent recurrences.

Patients acquire skill very readily in the passage of their own bougies, and, the œsophagus becoming, as it does, accurately sensitized, they are able to judge exactly the level in the œsophagus reached by the tip of the sound.

(2) *Radical Operation.*—When these methods of treatment by the mouth fail, dilatation should be performed from below, the cardia being stretched either by the fingers of the operator or by a pair of long-bladed forceps protected by rubber tubing inserted through a gastrotomy. An alternative operation is one similar to the modern operation for congenital hypertrophic pyloric stenosis, but differs from it in that after a longitudinal incision through the muscular coats of the œsophagus has been made, sutures are applied so that the vertical wound comes to lie transversely. This is therefore somewhat analogous to pyloroplasty, but the mucosa is not incised. It is known as cardioplasty (Wendell and others). Some workers, however, have found that sutures may be omitted after the incision has been made, as in Rammstedt's operation.

Another operation that has been devised is to draw down the lower end of the œsophagus through the diaphragm and anastomose it to the stomach (œsophago-gastrostomy). It is usually performed by the abdominal route, but has been done by the transpleural route (Lambert, Kirschner, Zaaier).

After-treatment.—Four feeds a day are sufficient for the patient and at first should consist of milk or egg and milk. A normal diet is resumed gradually, but should contain no small rough particles. The patient must chew his food thoroughly and eat slowly. At the end of each meal he should drink half a pint of water in order to wash any food retained in the œsophagus into the stomach. Half an hour later the œsophagus should be evacuated, either voluntarily or by an evacuator, and he should go on doing this every day until no fluid can be returned.

(3) NEUROPATHIC AFFECTIONS IN THE COURSE OF THE ŒSOPHAGUS

Spasms occurring in the Course of the Œsophagus).

TYPES

- I. Psychical œsophagismus.
- II. Reflex œsophagismus.
- III. Symptomatic œsophagismus.

GENERAL PATHOLOGY

Spasm in the course of the œsophagus is not characterized by the presence of any definite anatomical lesion, nor is any causative factor constantly found. Subsequent pathological phenomena, however, may occur, especially a dilatation and hypertrophy of the wall above the lesion, sometimes with the formation of diverticula, and often accompanied by the inflammatory process of œsophagitis. As has already been pointed out, this maintains the spasm reflexly and is the chief factor in transforming a transient or paroxysmal spasm into one of a permanent nature. The area of inflammation may be followed by fibrosis and contraction, thus leading to an organic cicatricial stenosis.

The theories of the ætiology of spasmodic contractions of the œsophagus were discussed above, and all that need be added are the essential facts referable to the special pathology of the three above-mentioned types.

SPECIAL PATHOLOGY

TYPE I. Psychical Œsophagismus.—The causative factor in this variety is a slight mental shock or apparently trivial apprehension occurring in an hysterical subject, usually a young female. Any fright, or the fear of a disease (for example, rabies), or any abnormal emotion (for example, the terrors of war), may cause this type of œsophagismus. F. Lemaître believes that, although impossible to demonstrate clinically, a small superficial lesion of the œsophagus which would pass unnoticed by a patient with a normal mentality will, in a neurotic subject, produce a violent reaction and thus form the basis of what is apparently a purely psychical œsophagismus.

TYPE II. Reflex Œsophagismus.—A very large number of diseases which cause either conscious pain or subconscious irritation of the nervous system have been known to produce œsophagismus in a reflex manner. These may be situated—

(1) In adjacent organs—laryngeal or pharyngeal ulceration and gastric diseases.

(2) In more remote organs, uterine and intestinal diseases being the most important.

TYPE III. Symptomatic Œsophagismus.—This type occurs most commonly in—

(a) *Lesions of the œsophagus itself*, the descriptions of which are embodied in the main substance of this work. The spasm is usually produced at the level of the lesion, but very frequently occurs at one or other extremity, especially at the mouth of the œsophagus, or, perhaps most commonly, both here and at the level of the lesion.

(b) *Organic diseases of the central or peripheral nervous system* account for a small number of these cases. As examples of central lesions, it must be noted that the condition may occur in tabes, in tumours of the bulb, in bulbar palsy (now considered to be a manifestation of progressive muscular atrophy or chronic poliomyelitis).

Peripheral nervous lesions are usually either due to compression of the vagus by an aneurysm or a mediastinal tumour or occur in cases of ascending neuritis. Diphtheritic infection not only affects the œsophageal wall itself, but also acts upon the peripheral nerves and central nervous system.

(c) *Toxic Causes.*—These usually act through the nervous system, and may be described as :

- (1) Poisonous drugs.
- (2) Infectious diseases.
- (3) Metabolic diseases.

Amongst the poisonous drugs may be mentioned coniine, arsenic, nicotine, belladonna, and lead.

The chief infectious diseases affecting the œsophagus are rabies, tetanus, influenza, typhoid fever, and diphtheria. The two latter may cause actual œsophageal ulceration.

Perhaps the most important of the causes of symptomatic œsophagismus is gout. The type of this disease known as suppressed gout is particularly commonly associated with œsophagismus, and is frequently found to be the cause of cardiospasm occurring in men of about the age of 40—so much so that R. J. Howard teaches that “cardiospasm is a disease of neurotic young women of 20 and of men of 40 who suffer from gout”.

DIAGNOSIS

A history of the sudden onset of dysphagia with irregular development of symptoms in a neurotic woman is very suggestive of spasm, especially if the condition is found to respond to antispasmodics. Nevertheless, a careful and complete examination of the patient must be made in order that the diseases enumerated above, of which œsophagismus is but a small manifestation, may be excluded.

On radioscopy the radio-opaque material is seen to be arrested and may undergo oscillatory movements and then suddenly be passed. The tapering effect seen in organic stenosis may be absent from cases of spasm.

Œsophagoscopy is next performed, and shows, if the spasm is at the upper extremity, the posterior wall of the œsophagus tightly applied to the cricoid. In the thoracic region longitudinal radiating folds of mucous membrane are seen leading to a central punctate orifice. In order to see this clearly it may be necessary to wash out the œsophagus, with the patient lying supine with the head a little lower than the trunk. Great care should be taken that no organic lesion is missed. At whatever level the spasmodic obstruction occurs considerable resistance is encountered when any attempt is made to pass the tube, but steady pressure for a few moments usually overcomes the spasm.

Under direct œsophagoscopic vision, catheterization may be performed with an olivary bougie. Pressure overcomes the spasmodic obstruction, and no bleeding or portions of a tumour should make their appearance. By moving the bougie when it has passed the spastic area it becomes apparent that the spasm varies in intensity from moment to moment. Any superimposed lesion, for example œsophagitis or diverticulum, if present, should be discovered and carefully examined at the same time.

Differential Diagnosis.—The clinical course of a case of acute spasm is usually quite typical, though it must not be forgotten that the symptoms of new growth may have a very sudden onset. Only by carrying out the methods of examination given above will mistakes be avoided.

The rarity of spasms occurring in the thoracic course of the œsophagus should make the examiner very careful not to overlook a mediastinal lesion—for example, aortic aneurysm.

Again, it must not be forgotten that even in a typical spasmodic case in which a long history is obtainable, with no history of a corrosive or foreign body having been swallowed, carcinoma may supervene.

TREATMENT

In the acute psychical cases antispasmodic treatment is instituted; the patient should be isolated, and bromides, valerian and belladonna, given. Local antispasmodics are applied by painting.

Catheterization, as indicated above, is frequently of great service, its effect being produced mainly by suggestion.

Cases of so-called "permanent spasm" are best treated by dilatation, which should preferably be performed under the control of the vision. Metallic dilators have been used, but they are more dangerous than the rubber or gum-elastic variety. Guisez passes two small bougies, one after the other, followed by a third and larger bougie between the two small ones.

The treatment of the reflex and symptomatic varieties of œsophagismus is directed to the cause; any resulting spasm is treated by œsophageal bouginage.

The spasm accompanying a hypopharyngeal diverticulum, or following the operation for the radical cure of this condition, is discussed later (see p. 120).

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CHAPTER VIII

CHRONIC ŒSOPHAGEAL OBSTRUCTION DUE TO PRESSURE ARISING EXTRINSICALLY

PATHOLOGY

EXTRINSIC pressure may be exerted upon the œsophagus by enlargement of any of the structures which lie in contact with it, and these may be classified according to their position.

- (1) In the neck.
- (2) In the thorax.
- (3) In the abdomen.

In the neck the commonest causes are new growths of the larynx and trachea, and goitres of various types. This class forms a certain proportion of all cases of difficulty in swallowing. Dysphagia may be due to an involvement of the pharynx, and therefore not a true œsophageal obstruction.

When a patient has difficulty in swallowing due to an obstruction in the cervical region, a laryngoscopic examination which reveals a normal hypopharynx is sufficient to allow a diagnosis of true œsophageal obstruction to be made. An examination of the larynx and trachea by the same mirror, together with a careful examination of the neck, will almost invariably reveal the extrinsic cause in this situation if one is present.

In the thorax an aneurysmal dilatation of the arch or rarely of the descending portion of the aorta constitutes the commonest extrinsic œsophageal obstruction.

Enlarged glands in the posterior and superior mediastina are also a common cause, and their enlargement may be due to a variety of conditions.

The commonest type comprises those which are the seat of chronic inflammatory changes, to which may be superadded infection by the tubercle bacillus. Occasionally purely tuberculous glands are found.

Syphilis of the lymphatic glands occurs in this situation, especially in the tertiary stage of this disease, and causes gummatous changes in the glands which, by their close proximity to the œsophagus, cause obstruction of its lumen.

Malignant glands affected secondarily to a carcinoma of the breast are also not rare. Any primary carcinomatous focus situated below the thorax may cause sufficient infection of glands in this position to produce œsophageal

obstruction; sarcomata of testis and occasionally of ovary, lympho-sarcomata, and melanotic sarcomata of the skin also give rise to glandular involvement which may be present to a marked degree in the posterior mediastinum.

Lymphadenomatous glands may produce similar effects; they are almost always associated with typical glands elsewhere and with enlargement of the spleen.

A goitre may not exert pressure in the neck, but, if very large, may pass into the thorax and give rise to compression of the thoracic portion of the gullet.

In rare cases abnormalities of the vertebræ have been known to cause œsophageal obstruction. This occasionally occurs in marked kyphosis or scoliosis, though most commonly the œsophagus does not follow the curve of the vertebral column, or does so only to a very slight extent and not to a degree sufficient to cause kinking.

An abscess arising from a tuberculous spine has also been known to cause compression of the gullet in either the cervical or the thoracic portion.

A bony exostosis springing from a vertebra affected with spondylitis deformans is among the very rare causes of extrinsic pressure upon the œsophagus.

Any new growth of the lungs, pleura, or mediastina may also cause obstruction to the œsophagus.

In the abdomen the common cause of obstruction to the lower end of the œsophagus is a new growth of the stomach in the region of the cardia or the fundus. Occasionally an enlargement of the liver, whether inflammatory, cirrhotic, or malignant in nature, may produce a similar effect.

DIAGNOSIS

The clinical symptoms of œsophageal compression due to external tumours are by no means characteristic, and frequently do not differ from those caused by conditions in the œsophagus itself.

An insidious and progressive dysphagia makes its appearance and may eventually become complete. It is not associated with any special type of pain, but the usual œsophageal discomfort in the chest after taking food is often present.

Solids are more difficult to swallow than liquids, and their passage is stopped first.

A very careful clinical examination of the patient is the first essential. After this the most important aid to diagnosis is an X-ray examination (radio-scopic and radiography), and this should be insisted upon whenever possible as the first line of local investigation. A positive result is of the utmost help, but it must not be forgotten that, especially in the case of a mediastinal or lung tumour, and occasionally in cases of aneurysm, a negative picture may be obtained.

A large number of patients show doubtful shadows of enlarged glands.

If this is the only abnormality seen, œsophagoscopy must be performed: it frequently reveals that the obstruction is due to an entirely different cause.

Radioscopy is of special importance as an aid to the diagnosis of an intra-thoracic goitre, which frequently shows calcareous changes. Palpation of the neck may lead to little or no indication of the extensive condition present below the upper opening of the thorax. Percussion should have revealed a patch



FIG. 67.—Radiogram of a case of œsophageal obstruction due to a large mediastinal neoplasm.

of dullness. The condition has been mistaken for pulmonary tuberculosis, especially as dyspnœa is usually a marked feature of this type of case.

On œsophagoscopy the wall of the viscus is seen to bulge inwards at the level of the constriction, and its lumen therefore becomes curved and semilunar in shape. The whole canal may be deformed and displaced from its normal vertical direction.

As a rule, the surface of the convexity is smooth and covered with normal mucous membrane. Occasionally it is lobulated if the cause of the pressure is a mass of enlarged glands, to which it may even be seen to be adherent; local

œsophagitis, together with some inflammation of the mucosa above the level of the stenosis, may be present. On inspiration the wall is seen to be immobile and the usual dilatation fails to appear.

In the case of aneurysm, not only does the wall bulge inwards, but it also shows rhythmical pulsation corresponding to each heart-beat.

The exact nature of any enlarged glands is often difficult to determine. A primary new growth or evidence of pleural metastases may be found.

If no evidence of either malignancy or tuberculosis is obtained, syphilis must be thought of, and a course of anti-syphilitic treatment instituted.

TREATMENT

The main lines of treatment in all cases must be directed towards the cause of the condition ; the details of the widely divergent procedures do not fall within the scope of this work.

For the actual œsophageal obstruction gastrostomy is demanded if the stenosis is produced rapidly. Otherwise, except in the case of pressure by an aneurysm, when under no circumstances should instruments be passed, intubation may be instituted and prove very satisfactory for the relief of the dysphagia.

CHAPTER IX

DIVERTICULA

DIVERTICULA of the œsophagus produce œsophageal obstruction both by mechanical pressure and by causing secondary spasm of the œsophagus immediately below the orifice of the pouch. They must not be confused with dilatation of the œsophagus secondary to stricture or spasm of this organ.

DEFINITION.—By the term “Diverticulum of the Æsophagus” is meant a hernia of the mucosa and submucosa through the muscular layer of the œsophageal wall. This may be in the form of a simple depression, an invagination, or a pouch of variable size, which communicates with the lumen of the œsophagus by an orifice. It differs from a dilatation following an organic stenosis referred to above in that it does not involve the whole circumference of the œsophageal wall. In very rare cases is the muscular layer incorporated in the wall of a diverticulum. (See pp. 52, 123, and 126.)

CLASSES.—Diverticula of the œsophagus are classified according to their position.

A. The first group comprises those situated at the junction of the pharynx and œsophagus which are referred to as “Pharyngo-œsophageal” or “Pharyngeal-pulsion” or Zenker’s Diverticula.

B. The second group includes those occurring in the œsophagus below the upper opening or mouth of this canal.

C. The third group consists of so-called “Congenital Diverticula”, which do not as a rule communicate with the œsophageal lumen, and therefore do not come under the heading of true diverticula (but see p. 52).

TYPES.—There are three clinical and pathological types of œsophageal diverticula, known as—

- (1) Pressure Diverticula.
- (2) Traction Diverticula.
- (3) Pressure-traction Diverticula.

1. **Pressure Diverticula.**—By a pressure or pulsion diverticulum is meant one which is developed as the result of pressure exerted from within the lumen of the œsophagus outwards.

2. **Traction Diverticula.**—Diverticula which arise as the result of an inflammatory process occurring outside the wall of the œsophagus, with adhesions

and subsequent contraction of these, thereby causing a distortion of a localized area of the œsophageal wall, are known as "Traction Diverticula".

3. **Pressure-traction Diverticula** occur as the result of a force acting from within following the effect of a contraction from without.

These classes and types of diverticula will now be discussed in detail in the following order :

I. **Diverticula occurring at the Pharyngo-œsophageal Junction, i.e. Zenker's Diverticula.**—These are held to be pressure diverticula, although some authorities maintain that the condition may occasionally be produced by both traction and pressure.

II. **Diverticula of the Œsophagus Proper.**—The varieties of these in their order of frequency are :

- (1) Traction.
- (2) Pressure-traction.
- (3) Pressure or Pulsion.

PHARYNGO-ŒSOPHAGEAL DIVERTICULA

This now well-recognized type of œsophageal diverticulum was first described in detail in 1877 by Zenker and Ziemssen in their classical memoir, in which they dealt with 34 cases. The condition, however, had been previously noted by Cruveilhier in 1852, and it was considered a rare disease until its relative frequency was demonstrated by X-rays and œsophagoscopy.

PATHOLOGY

A. **ÆTIOLOGY. Theories of Origin.**—Many theories have been advanced in regard to the pathogenesis of this diverticulum, and these will be discussed *seriatim*.

(a) *Theories of Congenital Origin.*—It is important to remember that the pharyngo-œsophageal diverticulum is always situated immediately above the mouth of the œsophagus and commences posteriorly.

Albrecht's theory, based upon comparison with the pharyngeal pouch of the pig, cannot therefore be maintained, as such a structure is considerably above the level of the upper end of the œsophagus (but see p. 52).

König's theory of arrested development of the œsophagus may similarly be disregarded, as any such abnormality occurs almost invariably at the level of the bifurcation of the trachea.

Ascherson and Klebs considered that vestigial branchial clefts had a bearing on the formation of diverticula, but these clefts are always lateral in position and rarely communicate with the œsophagus.

(b) *Theory of Mechanical Origin.*—The hypothesis of a purely mechanical origin of these diverticula has been widely held for many years, but upon an erroneous pathological basis.

The weakest point of the œsophageal wall has been described as being

situated at the lower border of the inferior constrictor muscle, between the two diverging bands of longitudinal fibres of the œsophagus. The posterior wall of the œsophagus in this region, the so-called triangle of Laimer, gains little support, whereas anteriorly the cricoid cartilage forms a complete resistance, and laterally the œsophagus is supported by the lobes of the thyroid gland. Many writers have averred that it is on the posterior wall at this level that a pharyngo-œsophageal diverticulum originates. This is now known to be entirely erroneous, and an exact statement of the true facts regarding the precise position and cause of origin of a Zenker's diverticulum is given below.

(c) *Modern Theory.*—The true site of commencement is situated above the lower fibres of the inferior constrictor. These lower fibres form the crico-pharyngeus muscle, which runs from side to side without decussation or raphé-formation. Above these fibres the main mass of the inferior constrictor muscle lies, and the fibres from either side may be seen to decussate in the mid-line, the lowest being directed backwards and in a slightly upward direction.

The crico-pharyngeus muscle is known as the superior sphincter of the œsophagus ; a pharyngeal diverticulum always arises above this.

The diagrams given with the description of the more minute anatomical relationships of the neighbourhood show the differentiation of the transverse fibres of the crico-pharyngeus muscle from the obliquely-placed fibres of the inferior constrictor muscle (Fig. 1, p. 6).

This situation is normally the narrowest and least distensible part of the gullet (Filoux and Mouton). Keith supports this view. He points out that a bolus rapidly reaches this narrowest part of the pharynx and is then squeezed between the cricoid in front and the supra-crico-pharyngeal triangle posteriorly.

If a purely mechanical theory of origin of Zenker's diverticulum is accepted, there would appear to be no reason why any one individual should develop a pharyngo-œsophageal diverticulum, or, conversely, why it should not be found in everyone. But, if the phenomena of normal and abnormal deglutition are taken into account, together with the mechanical and anatomical facts, a true explanation of the manner of origin of this diverticulum may be deduced.

In normal deglutition, when a bolus has passed below the mouth of the œsophagus the sphincter at this level remains closed until the peristalsis of the œsophagus has transmitted its contents into the stomach. It is interesting to note that almost all sufferers from Zenker's diverticulum have been in the habit of "bolting" their food, and therefore each succeeding bolus is arrested above the superior sphincter of the œsophagus until the preceding one has passed into the stomach, and, instead of the force of pharyngeal propulsion being utilized to press the food well into the lumen of the œsophagus, it all becomes dissipated on the walls of the canal at this level. The natural weakness of the region ultimately allows a slight protrusion of mucous membrane, which easily becomes enlarged. Some authorities, notably Guisez, lay great stress upon a primary spasm of the sphincter of the upper end of the œsophagus as occurring in the majority of cases before the development of a pouch. Should this occur, the mouth of the œsophagus does not open at

the right moment in the act of deglutition, and consequently the pharynx tends to dilate and its wall to give way at the weakest point. This strongly supports my contention that over and above the purely mechano-anatomical theory there has been abuse of the function of deglutition on the part of the patient.

The conclusion, therefore, is that a pharyngo-œsophageal diverticulum arises on the posterior wall of the hypopharynx by means of mechanical pressure causing an evagination of the mucous membrane through the very small triangular space bounded below by the transverse fibres of the crico-pharyngeus muscle, and above by the obliquely-placed lowest fibres of the remainder of the inferior constrictor muscle. In addition, the lower boundary of this triangle is the actual superior sphincter of the œsophagus, and a spasm or misuse of this sphincter must occur to disturb the normal mechanical and anatomical conditions.

Predisposing Causes.—It occasionally happens that definite organic stenosis in the region of the upper end of the œsophagus causes an obstruction to the mouth of this organ, and therefore increases the pressure in the lowest part of the pharynx. Such organic stenoses may be of extrinsic origin, *e.g.* goitre, aneurysm, or lymphadenitis, or due to intrinsic paralysis of diphtheritic or typhoidal origin, or may follow poliomyelitis of the cervical cord; they have occasionally been found in patients showing a true Zenker's œsophageal diverticulum (Bensaude and Rivet).

Heredity.—Heredity does not appear to play any part in the formation of pharyngo-œsophageal diverticula; Umber, however, records diverticulum-formation in a father and his son.

Age and Sex.—The patient is almost invariably an adult, the mean age in 35 cases analysed by Judd being fifty-four. With regard to sex, the males predominated in the proportion of 28 male to 7 female in the same series of cases.

B. MORBID ANATOMY. Site.—The site of origin of Zenker's diverticulum is always on the posterior wall of the pharyngo-œsophageal junction, exactly opposite the cricoid cartilage. The mouth of the diverticulum is bounded below by the lower fibres of the inferior constrictor muscle, called the crico-pharyngeus muscle, and above by the obliquely-placed and decussating fibres of the remainder of the inferior constrictor.

Development and Progress.—The development and progress of the herniation are usually slow and may take many years before symptoms cause the patient to seek medical advice. Systematic post-mortem search does, however, frequently disclose very early and unsuspected diverticula. Development takes place from above downwards on account of the force of pharyngeal propulsion and the weight of food entering the diverticulum. The sac first passes behind the œsophagus and then, taking the path of least resistance, passes laterally under the cervical muscles, usually to the left side, where it may form a distinct swelling in the posterior triangle. Still further increasing in size, the pouch comes to lie in contact with the dome of the pleura, often

entering the thorax, but always remaining in close apposition to the trachea and œsophagus.

The Orifice.—The orifice of the pouch is large in these diverticula, which tend gradually, as they increase in size, to incorporate the pharyngeal wall, and hence to press the mouth of the œsophagus against the larynx. The main channel of the pharynx therefore tends to pass directly into the lumen of the pouch, into which food or instruments easily pass, while the superior opening into the œsophagus becomes constricted immediately below the orifice of the sac. The rapidity of enlargement of the diverticulum is in direct proportion to its size, and, as it elongates, its orifice occasionally, though rarely, becomes constricted. When distended, the diverticulum forms a large tumour which compresses not only the œsophagus but, in the thorax, may also distort the trachea and great vessels.

Size and Shape.—Both the size and the shape of the diverticulum are variable. The shape is described typically as being pyriform; the size when first seen is seldom less than that of a bantam's egg, and cases have been recorded in which the capacity of the pouch reached over 20 ounces.

The Wall.—The wall of the sac consists of mucous membrane and submucosa, together with fibro-cellular connective tissue. It becomes gradually thinner as the pouch increases in size, and is especially thin at the bottom of the sac. A small sac, therefore, is found to have thick mucosa with a thin surrounding layer of connective tissue, and may easily be separated from adjacent structures, whilst a large sac shows a thin mucous layer with thicker and more adherent connective tissue.

Around the orifice the separated fibres of the inferior constrictor muscle are found in the wall. Below can be seen the transversely-placed fibres of the crico-pharyngeus muscle, which are in a state of spasm during life and by their contraction close the mouth of the œsophagus. Above can be seen the obliquely-placed decussating fibres of the remainder of the inferior constrictor muscle. No acquired hypopharyngeal diverticulum with a complete muscle layer has been recorded.



FIG. 68.—Hypopharyngeal diverticulum. Sagittal section showing larynx and trachea, with pharynx, diverticulum, and œsophagus. (Royal College of Surgeons Museum.)

In the accompanying illustration (Fig. 69) the dense band of the crico-pharyngeus muscle is seen below the orifice. Below this is the weak triangular space bounded at the side by the band of longitudinal fibres of the œsophagus: it is clear that this triangle bears no relation to the site of origin of the diverticulum.

The mucosa of the pharynx is continued into the diverticulum and tends to proliferate and become papillomatous or granular.

Actual ulceration may occur through food stagnating in the pouch. The

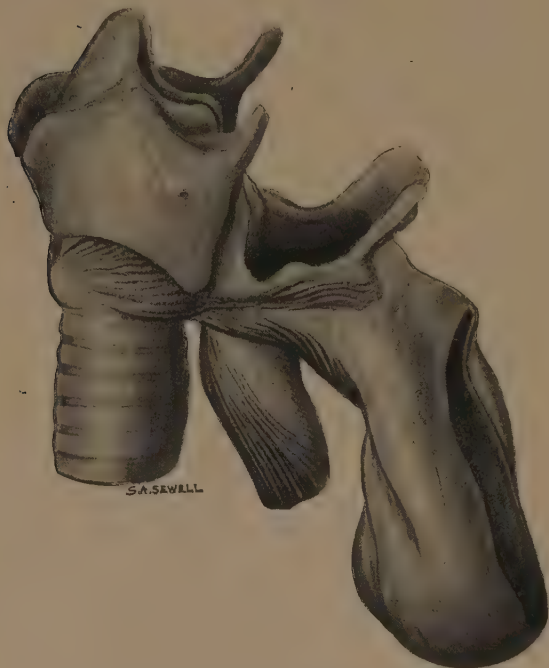


FIG. 69.—Dissection showing hypopharyngeal diverticulum with fibres of crico-pharyngeus muscle below its mouth and lowest fibres of remainder of inferior constrictor above. (Royal College of Surgeons Museum.)

ulceration may spread upwards as far as the mouth of the sac and affect the mucous membrane of the adjacent œsophagus; it frequently causes a secondary spasm of the mouth of the œsophagus. Local suppuration may occur in the retropharyngeal, mediastinal, or peri-œsophageal tissues, with or without spontaneous perforation of the diverticulum. Carcinoma has occasionally developed in the mucous membrane of one of these pouches (Edgren).

The Contents of the Sac.—

In the early stages of the development of a diverticulum the pouch contains unfermented and undigested food, with an admixture of a little mucus; lactic and hydrochloric acids cannot be demonstrated in it, and its reaction remains alkaline.

Later, when further stagnation takes place and ulceration and erosion of the mucous membrane are present, the contents consist of staler food, which has a foul smell, gives a foetid odour to the breath, and contains a larger proportion of mucus or even muco-pus, and from time to time a little blood. In reaction the contents are frequently found to be acid, and mistakes in diagnosis have therefore been made, as the clinician has relied on the presence of an acid reaction as indicating that the regurgitated material has come from the stomach. Careful investigation, however, shows the acidity to be due to the presence of lactic and butyric acids resulting from the fermentation occurring in the diverticulum, and fails to demonstrate the presence of hydrochloric acid.

The tests are fully described in the section dealing with general methods of diagnosis (p. 44).

Post-mortem Appearances.—These are similar to those described under the heading of Pathology (p. 102), and as seen at operation, together with any secondary lesion, *e.g.* mediastinitis, pulmonary gangrene, or septicæmia, which has been the immediate cause of death.

DIAGNOSIS

(1) **SYMPTOMATOLOGY.** (a) **Prodromal Symptoms.**—The actual time of the appearance of a diverticulum is rarely ascertainable, patients experiencing minor symptoms for some years before a careful examination reveals the presence of this abnormality, during which time the general health remains unaffected. The prodromal symptoms—a slight difficulty in swallowing, a scraping or roughness in the throat, together with a sensation of dryness—frequently do not appear to be worthy of careful investigation by the practitioner. They are very often accompanied by more definite symptoms, which should be most carefully enquired for, and should excite the suspicion of an organic lesion. Amongst these are the expulsion of thick glairy mucus on clearing the throat, often accompanied by abundant salivation. The patient has the sensation of a foreign body in the throat and experiences a frequent desire to cough. In 12 of Judd's 35 cases the patient noticed as one of the earliest symptoms gurgling sounds in the neck while swallowing.

Occasionally nausea occurs early in the disease, and may suggest some affection of the stomach.

Only rarely is the onset of a diverticulum determined by a definite trauma, cases having been recorded in which a pouch appeared after injury by an intra-oesophageal foreign body, or an operation for cervical adenitis, or the unskilful passage of a sound.

(b) **Later Symptoms.**—More definite symptoms are produced when a pouch reaches a certain size—in the first place, on account of the entrance of food into it, with consequent compression of the œsophagus; and, secondly, by compression of neighbouring organs. The most important symptom is that produced by the obstruction, namely dysphagia. Perhaps the most characteristic feature of this dysphagia is that the patient experiences the sensation of gradual lowering of the site of the apparent obstruction, together with increasing difficulty in swallowing, and he may notice that certain attitudes are more conducive to ease in swallowing than others.

Presenting a marked contrast to cases of obstruction due to carcinoma, the most common complaint of patients suffering from diverticula is that they have difficulty in swallowing fluids, whereas small fragments of solid food pass with comparative ease. This, however, is by no means an invariable rule, for, as the pouch increases in size, its cavity comes to lie in the direct line of pharyngeal propulsion, and at the same time the mouth of the œsophagus becomes gradually smaller, both because of the reflex spasm of its sphincter

and because of the dragging of the tumour. Hence, in the early stages of the development of a diverticulum solid fragments easily slip past the orifice of the pouch, while fluid tends to be passed into its lumen; later, solid food passes directly into the pouch, while fluids rapidly fill this cavity, and further fluid is then passed into the œsophagus with comparative ease, even when it is almost impossible for any solid fragments to pass into the œsophagus at all.

This also explains why some patients have difficulty with the first few mouthfuls only, whilst others, in whom the sac exerts greater pressure upon the œsophagus, have difficulty only after they have taken enough food to distend the sac. As a meal progresses, discomfort and a sense of pressure in the neck

gradually increase, and the pouch may become so full that further passage of food down the œsophagus is completely stopped. When this occurs retro-sternal pain is experienced at any time up to twelve hours after taking a meal. Later, regurgitation of food almost invariably occurs, and gas and undigested food make their appearance.

Regurgitation may frequently be brought about by direct pressure upon the affected side of the neck. Should the regurgitated material contain food taken at an earlier meal, this constitutes a very characteristic sign. As previously stated, the chemical reactions of the regurgitated material show no gastric digestion and are



FIG. 70.—Radiogram of hypopharyngeal diverticulum.
Antero-posterior view.

usually alkaline in reaction, but may reveal the presence of organic acid in long-standing cases. In this case tests for lactic and butyric acid and hydrochloric acid must be applied in order accurately to ascertain the cause of the acid reaction.

Occasionally patients exhibit rumination, and if the pouch is not emptied regularly and completely there is fœtor of the breath. When the pouch no longer empties itself, ulceration of its wall and the results of the consequent toxic absorption begin to manifest themselves in the patient's general health. He begins to experience a variety of gastro-intestinal disturbances, notably anorexia, dyspepsia, and constant thirst and obstinate constipation due to the lack of fluids. Wasting occurs from insufficient nourishment, though



FIG. 71.—Radiogram of hypopharyngeal pouch—antero-posterior view.
Note.—In this picture opaque fluid appears to pass from bottom of pouch.



FIG. 72.—Diagram from radiogram of case shown in Fig. 71—lateral view.
Note.—Opaque fluid is seen to pass from upper part of pouch.

rarely, if ever, does the patient become as cachectic as in malignant disease.

Although rare, pressure symptoms sometimes develop, affecting the respiratory tract and causing dyspnoea. Pressure on the vessels of the neck may cause

congestion of the face. Pressure on local nerves may cause neuralgia in the cervical, brachial, thoracic, or interscapular regions. The patient may notice an alteration of voice, due to the pouch pressing upon the recurrent laryngeal nerve. All these pressure symptoms are most suggestive of a malignant growth, and are sometimes the cause of difficulty or even of error in diagnosis.

Should the diverticulum remain untreated a variety of complications may obtain. As already stated, local suppuration may occur. Death may supervene from this or from inanition, or from aspiration by the lungs of septic material from the pouch causing broncho-pneumonia or pulmonary gangrene.

(2) LOCAL EXAMINATION. (a)

Clinical Examination.—*On inspection* of the neck a visible tumour is seen in one-third of all cases, and may have been noticed by the patient himself to make its appearance during meals. In order that it may be demonstrated, the patient should be examined immediately after a meal with the neck held fully extended. The swelling will then be seen, usually on the left side, with a slight



FIG. 73.—Radiogram of pharyngeal-pulsion diverticulum descending in mid-line.

displacement of the trachea and larynx to the right. Sometimes it is on the right side, while more rarely still a general swelling is found in the mid-line with undue prominence of the larynx and trachea.

On palpation the tumour may frequently be felt. It appears soft, and may actually fluctuate. Its size may be diminished by pressure, and this causes regurgitation of the contents. If the patient then takes more food the tumour

enlarges again. If pressure is exerted from before backwards, the tumour gives a sensation of shrivelling as it empties (Hartmann). The patient may himself have discovered that he can distend the pouch with air at will. This may be done on instruction by the surgeon at the time of examination: pressure should be made upon the upper end of the œsophagus, and the patient directed to close his mouth and nose, at the same time endeavouring to swallow. By this means large gulps of air are forced into the pouch, and a previously undetectable pouch may now be both seen and felt.

Percussion over the distended pouch gives a sonorous note at its upper extremity, whilst lower down, and usually to the left of the sternum, the note is impaired, and occasionally a dull note is present along the vertebral border and near the upper angle of the scapula.

On auscultation, while pressure is made on the neck, gurgling or bubbling sounds are heard over the pouch. The constant presence of air mixed with the contents of the sac gives rise to sounds simulating borborygmi, and similar sounds are heard on each movement of deglutition.

Cooper has described a clapotage or succussion sign. To demonstrate this, a fasting patient drinks water, and, on the neck being rapidly moved from side to side, so-called "clapotage" is heard, due to the water in the diverticulum. Unfortunately for diagnosis, it may also be produced in dilatations of the œsophagus above stenoses.

(b) **Indirect Laryngoscopic Examination.**—Indirect laryngoscopy is performed as part of the routine investigation of the case. Bubbles of air mixed with mucus may frequently be seen in the hypopharynx, while in very late cases there may be evidence of pressure upon the recurrent laryngeal nerve.

(c) **X-ray Examination.**—By far the most useful and certain method of diagnosing the presence of a pharyngo-œsophageal diverticulum is a radioscopic examination. Immediately the clinical signs and symptoms lead one to suspect this lesion the case should be investigated by means of X-rays and a radio-opaque drink. This avoids blind catheterization with possible perforation of the bottom of a pouch or of an aortic aneurysm or of a neoplasm of the œsophagus. It is painless, devoid of danger, and also the earliest diverticula can almost always be recognized. Before the examination, pressure should be



FIG. 74.—Diagram of radiogram of same case as Fig. 73—lateral view.

made upon the neck in order to empty the pouch. In typical cases the opaque substance first fills the sac, and not until this is full is the shadow of the opaque material seen to pass down the œsophagus. Hence it is important always to give more than enough material to fill the pouch.

The chief points to note in the X-ray picture are the sharply defined outline of the shadow, which is rounded and regular, fills from above downwards, and empties from the upper part. The sac is usually very distensible and may

be watched filling. No opaque material is seen to pass through the lowest point of the swelling, though often the fluid may be seen to overflow from the top.

Certain anomalous observations may be made, and some care is required to avoid them. If the sac is very large it may completely obscure the shadow of the œsophagus and make it impossible to see whether the overflow is occurring from the top or the bottom of the opacity. In such a case an opaque sound may sometimes have to be passed into the œsophagus and the patient placed in the oblique position so that the shadows of the pouch and the œsophagus do not coincide.

If the radioscopic examination is undertaken with the pouch full of

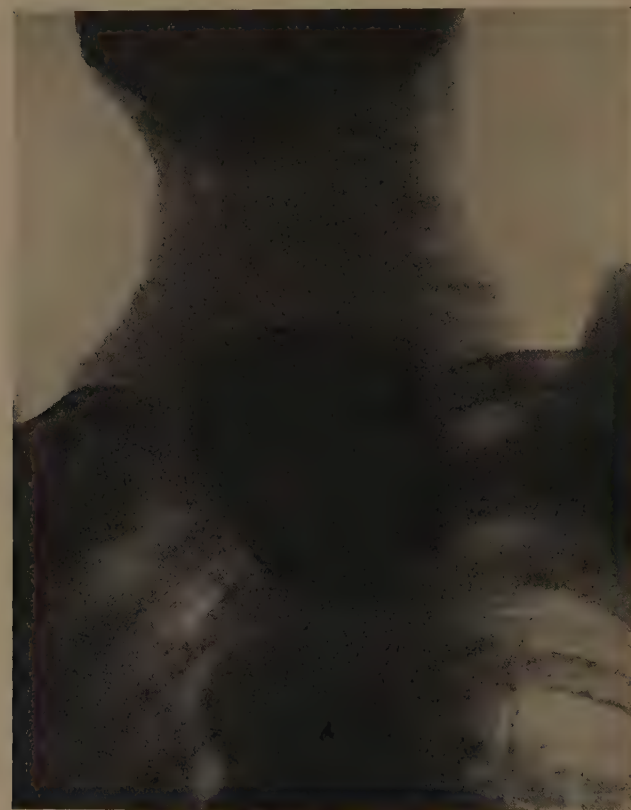


FIG. 75.—Radiogram of a very large hypopharyngeal pouch.
(Mr. Eric Young's case.)

food, the opaque material does not enter and the observer may be misled; the examination should therefore be repeated if there is any doubt on this point. The condition which most closely simulates the X-ray appearance of a Zenker's diverticulum is a marked dilatation of the œsophagus occurring above an organic stricture.

The lower margin of the shadow thrown by an opaque fluid in such a dilatation is not so well defined as in the case of a pouch, nor is the shape so regular. The fluid is seen to pass through the lowest part of the

dilatation, whilst in inflammatory stenoses the dilatation is seen to narrow gradually.

In spite of such well-marked characteristics, errors may occasionally arise (3.6 per cent in 250 cases of diverticula collected by Keppler and Erkes). These are usually diverticula occurring above cancerous or fibrous strictures.

(d) **Œsophagoscopy.**—After radiosopic examination, œsophagoscopy is the most important aid to the investigation of this class of œsophageal obstruction. It was first used by Waldenburg in 1870. Improvements have since been made on his first instrument by very many workers. The instrumentarium and technique of œsophagoscopy have already been fully described (pp. 30-43).

Three important points are to be noted in the diagnosis of a diverticulum by œsophagoscopy:

(1) The fact that the passage of the tube is arrested some 7-8 inches from the incisor teeth.

(2) The tube enters a closed cavity.

(3) The œsophageal lumen may be difficult to find.

Points already noted in the pathology of the condition are now obvious (see Fig. 79 and Plate I. n). The pharynx appears to pass directly into the sac, the floor of which is seen to be inflamed, and care must be taken, as it may easily be damaged and possibly perforated. On withdrawing the tube the anterior border of its mouth may appear to form a lip or projecting fold. When this is seen the spatula or beak of the examining tube should be held close to the cricoid, and with steady pressure, or if the patient swallows, the endoscope will pass into the œsophagus.

In order to make certain that the œsophageal lumen is actually seen, the following method may be adopted. The day before the œsophagoscopic



FIG. 76.—Radiogram of a large pharyngo-oesophageal pouch.

examination the patient should swallow a guiding-thread (Plummer's method) (see p. 46). At the time of the examination a metal sound having an orifice for the thread at its extremity is first passed over the thread. The œsophagoscopic tube is then passed over the sound and the orifice of the pouch is looked for posteriorly, while the œsophageal opening is seen anteriorly against the cricoid. It may or may not be possible to see both orifices simultaneously.



FIG. 77.—Radiogram of hypopharyngeal diverticulum.

is ascertained accurately. If, however, a dilatation or stricture arrests the progress of the probe, its position remains unaltered when the thread is drawn taut. If a sac is present the permeability of the œsophagus may be tested by a further attempt to pass the sound after tension has been made upon the thread. After the examination the remainder of the thread is swallowed and subsequently leaves the body *per vias naturales*.

Some authorities have thought it advisable, on occasion, for the patient to swallow two threads, and for two bougies to be passed, one into the pouch and

(e) **Catheterization.**—This method of investigation is rarely required if X-ray examination and œsophagoscopy are available, and bougies are to be avoided if possible. If it appears imperative that a sound should be passed, the following rules must be adhered to, namely: (1) the sound must not be passed blindly; (2) X-ray examination must first be performed if possible. Should this be impossible, the sound must first be passed over a guiding-thread, and the operation performed with the patient fasting, or after a vomit or regurgitation. A bulbous-ended hollow probe is passed over the thread and downwards into the diverticulum, when it may frequently be felt through the neck. In the presence of a diverticulum, when the thread is drawn taut the bulbous end is pulled upwards to the mouth of the pouch, and thus the depth of the pouch

another into the stomach. radiogram then taken showing one in the cavity of the pouch and the other in the cavity of the œsophagus.

A crutch-sound has been used to demonstrate the orifice of a sac and its relation to the œsophagus. With the crutch turned backwards, or backwards and to the left, it enters the cavity of the pouch.

It now gives the impression of being in an open space and of not being impeded by any stricture. When turned forwards the crutch may enter the œsophagus, and then conveys the sensation of being grasped by the spasmodic upper end of this tube.

At the best of times, catheterization is a blind diagnostic measure —



FIG. 78.—Radiogram of same case as in Fig. 77—oblique view.



FIG. 79.—Esophagoscopic appearance of mouth of œsophagus and mouth of hypopharyngeal diverticulum.

dangerous and erroneous—and its value has been reduced to a minimum since X-ray examination became generally available.

(3) GENERAL EXAMINATION.—A careful general examination of the patient must be undertaken in order to be sure that he is fit to stand an operation of moderate severity. Patients who are found to be suffering from severe inanition should have their general condition improved before any local surgical interference is undertaken. For the more severe cases a gastrostomy is indicated, while for the less severe all that may be required is dilatation of the crico-pharyngeal sphincter, always under direct vision, with or without feeding by means of a tube.

Cases in which there is a marked oral sepsis require most careful preliminary dental treatment, in order that the risk of infection is reduced to a minimum. After dental extractions three or four weeks must be allowed to elapse for the gums to heal, and during this time medical treatment should be undertaken as detailed later.

A general examination of the patient should lead to an opinion as to whether a local or a general anæsthetic would be the more advisable. As a general rule a local anæsthetic is sufficient if pre-operative hyperdermic medication is given ; but for large and adherent pouches a general anæsthetic—preferably intra-tracheal gas and oxygen—is advisable.

CHAPTER X

TREATMENT OF PHARYNGO-ŒSOPHAGEAL DIVERTICULUM

THE treatment of pharyngo-œsophageal diverticulum is discussed under the following headings :

- I. Prophylaxis.
- II. Treatment in Developed Cases.
- III. Post-operative Treatment and Complications.

I. PROPHYLAXIS

A little must be said of the prophylactic treatment of this type of pouch. As it has been shown that certain prodromal symptoms, and occasionally a definite history of trauma, precede the formation of such a diverticulum, it is essential to ensure that any patient who exhibits symptoms of a lesion at the mouth of the œsophagus has any predisposing factor treated. For example, a specific ulceration, or ulceration from foreign body, or stricture from gun-shot wound, or similar condition causing spasm or stricture of the upper end of the œsophagus may be followed by the formation of a pharyngo-œsophageal diverticulum.

It is well known that if such an inflammatory stenosis or spasmodic contraction of the mouth of the œsophagus can be caused to retrogress, an apparently commencing diverticulum can be prevented from developing. This is best accomplished by regular and progressive dilatation, carried out for a considerable period of time.

II. TREATMENT IN DEVELOPED CASES

The actual treatment of an established case may be subdivided into :

- (A) Medical.
- (B) Surgical.

(A) MEDICAL TREATMENT

Medical treatment in the case of a diverticulum should first be utilized if there is any delay in having recourse to surgical measures or if the latter are contra-indicated.

Dilatation.—While the patient is undergoing medical treatment instrumentation should be undertaken with a view to dilating the mouth of the œsophagus; but the passage of sounds is not without danger, as there is always the risk of perforation of the pouch. Before it is performed, therefore, radioscopic and œsophagoscopic examination must be made, and the sound always passed under direct endoscopic vision.

If this is impossible or intolerable, dilatation may be performed by Sippy's method: the patient swallows a thread, which is used as a guide to the introducer, the whole length of which bears Sippy's graduated olives, the largest ones being in the middle, and the sizes diminishing towards each extremity. Gradual dilatation thus takes place, without discomfort on withdrawing the olives, which, furthermore, then exert pressure from below upwards and thus express the contents of the diverticulum (p. 47).

Care of the Pouch.—In addition to the regular dilatation of the superior sphincter of the œsophagus, the cavity of the sac should be washed out by means of a tube, such as an ordinary soft rubber catheter. This lavage should be performed twice a day, using a mildly alkaline solution. It may be carried out by the patients themselves in a certain number of cases, or may be performed without the passage of a tube by the patient taking a copious drink and then regurgitating whilst pressure is applied to the sac. It is the duty of both the doctor and the patient to ensure that the diverticulum is always empty, except at the actual time of taking a meal.

Manner of Eating.—The manner of eating must be attended to carefully. Food should be well masticated and no large bolus swallowed. Attention must be given to diet. The patient has usually learned from experience the type of food that passes with the least difficulty, and such experience may well serve as the basis for his dietetic régime. In general he should be encouraged to take foods prepared with liberal amounts of fat or oil, thick soups, boiled fish, farinaceous food, raw or lightly boiled eggs, and other bland foods of soft consistency; whilst alcohol in any form, highly seasoned dishes, and foods containing any particles likely to act as irritants should be prohibited.

It frequently happens that a certain posture is noticed by the patient to be conducive to ease in swallowing, and this posture should be adopted while eating.

General Health.—Any focus of infection in the nasal sinuses or mouth must receive careful attention. The teeth, especially, must be examined, and any affected with pyorrhœa or caries should be extracted. Should the patient object to this they must be cleaned as far as possible. This is a most important point, and one which I wish especially to stress. It is true that it is quite impossible completely to sterilize the pharynx or œsophagus or the inside of any pouch; nevertheless, there is such an enormous difference between the organisms present in the pharynx or diverticulum in a patient with a clean mouth and in one affected with pyorrhœa or caries, that, if a radical extirpation is contemplated, careful attention to the teeth may make all the difference between success and failure, or even between recovery and a fatal termination.

I maintain that the one-stage operation may be undertaken lightly in a

patient with a clean mouth and that the two-stage operation may only be undertaken with misgivings in a patient who refuses, even after the greatest persuasion, to have the mouth rendered as clean as possible.

Hygienic, dietetic, and medicinal treatment for the general health must be carried out, and general tonics, except strychnine, should be exhibited to patients with this condition. To increase the tone of the œsophageal wall faradism has been proposed, but has been found to be useless.

In advanced cases in which operation is contra-indicated, feeding by means of an œsophageal tube, *e.g.* Hill's, for some two or three weeks every three months frequently proves beneficial, leading to improved deglutition when the tube is removed. If this method is being adopted X-ray examination should be performed from time to time in order to ascertain whether the sac is increasing or diminishing in size.

(B) SURGICAL TREATMENT

(1) Palliative. (2) Curative.

(1) **PALLIATIVE SURGICAL TREATMENT.**—In certain cases, especially those where emaciation is marked, and in patients in whom a local operation is contra-indicated, gastrostomy should be performed, either as the main line of treatment or as a preliminary, with a view to performing a radical operation when the general condition of the patient renders this more certain of success. It has been recommended by König, Payr, and Bevan, and serves to keep clean the area of operation for some time beforehand. It enables the patient to obtain more nourishment than he has had for a considerable time past and builds up his strength, making the prognosis of a radical operation much more favourable.

(2) **CURATIVE SURGICAL TREATMENT** is undertaken in all cases in the absence of contra-indications.

Bell, in 1830, recommended making an external fistula into the sac.

Cluge, in 1850, advised extirpation, which was first performed by Nickhaus in 1884.

Local surgical treatment of pharyngo-œsophageal diverticula was also performed by von Bergmann and Kocher in 1892. Their operation was modified by Luepke, who introduced the use of a local anæsthetic in order to avoid broncho-pneumonia and vomiting, and in order that the patient might swallow during the operation. Since then a large body of workers has added to, or modified, the operative procedure, and the modern methods of treating this type of diverticulum are now described.

A variety of operations present themselves for consideration, and the choice of these depends upon—

- (1) The size of the pouch.
- (2) The degree of discomfort produced.
- (3) The degree to which the presence of this abnormality endangers life.

THE MODERN TREATMENT may be classified as follows :

- (1) Treatment from within.

- (2) Obliteration from without.
- (3) Change of position.
- (4) External surgical extirpation—
 - (a) One stage.
 - (b) Two stage.

1. **Treatment from within** may consist of invagination, which is applicable only to a very small sac, and the presence of many adhesions usually renders it highly impracticable.

Gaub and Jackson performed an endopharyngeal operation under direct œsophagoscopic vision. By this route they removed the sac and sutured the wall. Grave risk of infection accompanies this procedure, and it is not recommended.

Similarly, Mosher's division of the septum or party-wall between the pouch and the œsophagus must be condemned.

2. **Obliteration from Without.**—If the sac be very small the most suitable operation is a simple invagination of the pouch without opening the lumen of the œsophagus or pharynx, as was first performed by Girard in 1896. Little risk attends this operation and the results are satisfactory. A modification of this method is described by Sippy and Bevan, who, after dissecting the sac free, obliterate its cavity by purse-string sutures.

3. **Change of Position (Diverticulopexy).**—If the sac be of only small size a method of dealing with it is that described by Dundas-Grant and by Hill, and also adopted by Wildenberg and König, in which operation an incision is made along the whole length of the anterior border of the sterno-mastoid, usually on the left side. The sac is dissected from below upwards until it is freed, and its fundus is sutured to the lateral hyoid or mastoid region. The deep cervical fascia is then carefully united so that the space from which the diverticulum has been removed is obliterated. This operation is known as "Diverticulopexy", and its chief advantage is that the cavity of the gullet is not opened, and therefore the complications sometimes met with due to infection of the cellular tissues of the neck and mediastina do not occur. Following the operation the cavity becomes obliterated and the pouch ultimately converted into a mass of fibrous tissue.

4. **External Surgical Extirpation.**—If the pouch is of still larger size the only satisfactory method of dealing with it is that of radical extirpation. Whether this is performed in one or two stages makes little difference in the main points of operative technique.

(a) *The One-stage Operation.*—This operation is described under the following headings :

- (i.) Exposure.
- (ii.) Excision.
- (iii.) Reconstruction.

It is most important before commencing operation, especially when operating under a general anæsthetic, that the sac be carefully emptied and washed out, and this also holds good when a local anæsthetic is used. The local anæsthetic

recommended is a 1 per cent or 2 per cent solution of novocain, in 1 in 100,000 adrenalin. Of the 1 per cent solution 100 c.cm. can be used with safety. If a general anæsthetic has to be administered, it should be given either by the ordinary intratracheal method or by my intratracheal method after a pharyngotomy has been performed (see p. 199), the anæsthetic employed being gas and oxygen, or gas, oxygen, and ether.

(i.) *Exposure*.—An incision is made along the anterior border of the sterno-mastoid of the side on which the pouch is known to lie. The modern and most satisfactory incision is placed obliquely in the natural fold of the neck, with one-third of its length behind the anterior border of the sterno-mastoid and its centre opposite the neck of the sac. The skin and platysma are dissected in both directions, and scarcely any ligature is required. The deep fascia is divided along the anterior border of the sterno-mastoid, and this muscle, together with the omo-hyoid, retracted. Occasionally it is advisable to divide the omo-hyoid muscle. The corresponding lobe of the thyroid gland is then mobilized, and the common carotid artery and internal jugular vein retracted backwards. The sac, as a rule, is now easily found, its neck being behind and below the cricoid, and Deis's recommendation that a sound should be passed into its interior is rarely, if ever, necessary. Bartlett suggests that the patient should now be told to distend the pharynx with air with the lips and nose closed, if the operation is being performed under a local anæsthetic. This distends the sac, which is seen to be lighter in colour than the adjacent structures, and usually has a fine plexus of veins on its surface. The lower pole should first be isolated by blunt dissection, care being taken to avoid the recurrent laryngeal nerve. When this has been done, suitable forceps, covered with gauze so that it is not perforated, are applied to the fundus in order to prevent it from falling back into the thorax. (Figs. 80 and 81.)

(ii.) *Excision*.—With a sac of moderate size, and provided that the mouth has been rendered as aseptic as possible, this stage of the operation may be carried out immediately, *i.e.* the one-stage operation. The whole sac must first be carefully wrapped round and the wound packed with gauze soaked in a 1 in 500 perchloride of mercury solution. The neck of the sac is now clamped in a manner similar to the clamping of an appendix, preferably with three clamps, the middle one being removed and the compressed area being divided with the actual cautery, or with a knife, followed by the application of a drop or two of pure carbolic acid. Other workers prefer to cut through the neck of the sac a short distance from its attachment to the gullet, without the use of clamps.

The two-stage operation will be described later.

(iii.) *Reconstruction*.—A catgut ligature is passed between the œsophagus and the proximal clamp, and is drawn tight as the proximal clamp is removed. The remaining small stump is now invaginated with two layers of sutures.

If the neck of the sac has been cut through without clamps, two rows of chromic catgut are used, one for the mucosa and submucosa, and the second for the muscle-coat, thereby closing the œsophagus very much after the fashion

of an endo-aneurysmorrhaphy. A small soft rubber drain is now passed down to the area of operation, which may with advantage be covered with a little boracic acid in crystalline form. Gauze should not be used, as it tends to cause a fistula. The omo-hyoid, if divided, is united by catgut sutures, as is also the deep cervical fascia. The remainder of the wound is closed in the usual



FIG. 80.—Drawing from an operation, showing thyroid gland and trachea retracted forwards and sterno-mastoid and omo-hyoid muscles retracted backwards exposing a left-sided hypopharyngeal diverticulum.

Note.—The incision was made along the anterior border of the sterno-mastoid. For some time now I have abandoned this incision for a more transverse one in the natural fold of the neck, with its centre in line with, but at a lower level than, the neck of the sac.

way, leaving the drainage tube projecting in front of the anterior border of the sterno-mastoid muscle.

(b) *The Two-stage Operation.*—In the absence of a recognition of the cause and method of prevention of cellulitis, the modern tendency has been to perform the operation in two stages. At the first the sac is exposed as before and delivered to the surface unopened. It is then packed round with a layer of plain sterile gauze, or placed within a soft rubber drain, which prevents it

from uniting with the skin, but causes adhesions to form round the neck of the sac. Goldmann, in 1909, advised that when the sac is drawn to the surface a ligature should be tightly tied round its neck. The sac then usually sloughs away in ten days' time, or, if it has not done so by then, it may be cut off. This operation is favourably reported on by Judd and others as proving satisfactory, giving a low death-rate, is seldom followed by recurrence, and almost



FIG. 81.—Same case as Fig. 80, showing pouch drawn upwards exposing fibres of crico-pharyngeus muscle (preparatory to excision and suture).

never by fistula formation, which, if it does occur, heals rapidly. A more modern method (Mayo and others) is to omit ligation of the neck, and some ten or fourteen days later to excise the sac and suture the œsophagus as described above in the one-stage operation. Any leakage into surrounding tissues is then well shut off by the fibrous tissue which has developed since the first stage of the operation. The deep fascia and skin are closed as before, with a small drainage tube passing down to the œsophagus.

Wilkie and Hartley have suggested a modification of the two-stage operation with a view to offering a still greater protection against the risk of cellulitis.

It consists essentially of freeing and bringing out the sac at the first operation, and of a submucous excision of the lining at the second. The *tunica propria* is thus left adherent to the skin, and the planes of the neck are undisturbed. At the second operation the base of the projecting portion of the sac is incised until the loose submucous tissue plane is reached. By blunt dissection the mucosa is stripped off for about two inches from the skin surface, and the fundus, together with the freed mucous lining, is resected. The free edge of the mucosa is now inverted by a rolled-in suture of chromicized catgut, and further invaginated by interrupted sutures. The stump is then allowed to retract into the deeper parts of the wound, and the orifice partially closed by skin sutures. The operation is therefore carried out within the submucous layer of the diverticulum. Fistula formation is frequent.

Provided the mouth has been rendered edentulous and sufficient time allowed to elapse for the gums to heal, the one-stage operation is safe, easier, and gives more satisfactory results. In the presence of irremediable oral or pharyngeal infection, a two-stage operation must be performed. Even this in such a case has a greater risk than the one-stage operation in the relatively aseptic case.

III. POST-OPERATIVE TREATMENT

The patient should be kept in bed, preferably in Fowler's position, and all that is needed locally is careful cleansing and protection of the skin around the drainage tube, which should be removed gradually, and the track allowed to close from below upwards by granulation tissue.

It is undesirable to place a sound in the œsophagus after operation, as this tends to cause persistent vomiting, which drags upon the sutures.

It is advisable to rely upon rectal injections of saline and glucose for the first two, three, or four days after operation. Eight to ten ounces of a solution of 10 per cent glucose in normal saline every six or eight hours is usually well tolerated, but may be supplemented by hypodermatoclysis. The mouth should be carefully cleansed with alkaline solutions at hourly or even half-hourly intervals. I allow a patient to chew a piece of pine-apple occasionally, provided that none of the solid or fluid matter is swallowed. If a gastrostomy opening is present nothing whatever by the mouth need be given for five or six days. In a normal case feeding is commenced with fluid substances at first, followed by the softest of solids, until ten to fourteen days have elapsed.

Any residual inflammatory stenosis of the mouth of the œsophagus should be treated by regular dilatations, commencing some two or three weeks after the operation, until all symptoms of œsophageal obstruction have entirely subsided.

Complications.—The chief danger in all operations which open such a cavity as the pharynx or œsophagus lies in the possibility of infection of the cellular tissues of the neck and mediastinum with some of the most virulent organisms in the body. It may cause nothing more than a little local peri-

œsophagitis, which may easily be combated by the drainage tube left in position and the insertion of as much crystalline boracic acid as possible. It may, however, spread and develop into a violent mediastinitis with a fatal termination. It is preventible by rigid observation of the pre-operative and operative technique already enunciated.

Surgical emphysema of the neck and face sometimes occurs, but unless signs of suppuration present themselves it will disappear without any serious effects or after-effects.

Affections of the lungs, especially broncho-pneumonia, are mainly due to aspiration of some of the infective contents of the pouch. This is avoidable by using a local anæsthetic and by ensuring that the sac is empty before the operation begins.

The formation of a fistula sometimes occurs, but with careful attention to technique it should be possible to avoid it.

CHAPTER XI

DIVERTICULA OF THE ŒSOPHAGUS PROPER

THERE are two types of Diverticula which may occur in the wall of the œsophagus :

- A. Traction Diverticula.
- B. Pressure Diverticula.

A. TRACTION DIVERTICULA

These diverticula, occurring in the middle or lower portions of the œsophagus, seldom attain a size greater than 1 to 2 cms. in depth, are never large, are of little importance, and usually present no symptoms. They have been called "Tuberculous Diverticula of the Œsophagus", and were first described by Rokitsansky, and named "Traction Diverticula" by Zenker.

PATHOLOGY

The most frequent site of these diverticula is just below the bifurcation of the trachea at a point where the œsophagus and left bronchus cross, and almost always on the anterior œsophageal wall, and towards the left side. Traction is caused by inflammation of lymphatic glands in the neighbourhood of the œsophagus, which has been followed by fibrous contraction in the peri-œsophageal tissues. Kragh has made a most careful investigation of the pathology of this condition. He examined 556 individuals post mortem and found such adhesions in 14 cases, the glands showing late or recent tuberculous changes. In the majority of these cases extension of the inflammatory process to the œsophageal wall was found, and in several early signs of healing were present. In the minority of the cases the wall of the œsophagus contained a cicatrix, the tissue of the outer part of which passed into a tuberculous gland. These slight traction diverticula were serially sectioned; nearly all were adherent to lymphatic glands which had contracted and showed signs of late or recent tuberculosis. He found no proof that anthracosis of glands may give rise to adhesions between these and the œsophagus or to induration of the œsophageal wall. He also examined an ox which had recently died from

extensive tuberculosis, and found a fresh perforation of the œsophagus caused by necrosis of a tuberculous gland.

Similar results were obtained from work performed by Hausmann, Ribbold, and Brosch.

Some rare cases have been reported in which pulmonary tuberculosis, recurring inflammation of the pleura or pericardium, thyroiditis, mediastinitis, or vertebral caries has played a similar part. Some, again, occur where no connexion with morbid glands or other neighbouring lesions can be found. In such cases a fibrous track passes from the base of the diverticulum to the trachea or bronchus, but this track is either horizontal or directed upwards—that is to say, the opening is on a lower level than the body of the pouch, and therefore no collection of food occurs and no results of pressure follow.

Traction diverticula, therefore, are due to an invasive growth of the œsophageal epithelium through a perforation, or to a contraction by cicatricial tissues. These diverticula are occasionally multiple.

The structure of the wall of the pouch is variable. It may be exactly similar to that of a pressure diverticulum, *i.e.* simply a hernia of the mucosa; or all the layers may be involved. The summit or apex is mainly composed of fibrous tissue.

The chief complication of such a pouch is perforation by a foreign body, which may cause hæmorrhage, mediastinal infection, or a fistulous connexion with an air-passage. The complications are the most important aspect of the subject of traction diverticula.

As a rule the suppurating gland breaking down into the œsophagus heals, but secondary infection from the œsophagus may take place, first of the gland, then of the mediastinum, giving rise in the neck to a cervical phlegmon or even phlebitis of the internal jugular vein. In the chest, peri-œsophagitis and mediastinitis are likely to occur. Perforation may take place into the bronchus, causing a broncho-œsophageal fistula, or into the trachea, pleura, or pericardium, causing a pyopneumothorax, or suppurative pericarditis.

Perforation may also occur into a large vessel such as a vein, or even the aorta—death therefore ensuing from hæmorrhage. In spite of the previous statement that food does not enter these diverticula, in rare instances it has been known to do so, and hence a pressure-traction diverticulum results. Lastly, carcinoma may develop at the site of a traction diverticulum.

Age.—Traction diverticula are usually observed in adults—in males more commonly than in females—and in children rarely. Zenker and Petus each record one case in a child under 2.



FIG. 82.—Traction diverticulum.
(Royal College of Surgeons Museum.)

Frequency.—These diverticula are found in about 4 per cent of all autopsies, and are therefore the commonest form of œsophageal diverticula.

DIAGNOSIS

(a) **Symptomatology.**—There are frequently no symptoms of a traction diverticulum, or at any rate, they are very slight, because there is, as a rule, no tendency for food to enter, and stenosis is seldom produced. It is possible that slight discomfort is noticed on deglutition, with a very long history, and rare cases exhibiting retro-xiphoid pain have been described. Unless spasm supervenes, therefore, a traction diverticulum is not often diagnosed during life.

(b) **Radioscopy.**—X-ray examination seldom shows the presence of this type of diverticulum, because it does not fill easily. (See Fig. 84, p. 130, and Fig. 85, p. 141.) Palugay advises examination with the pelvis raised; by this means Helm diagnosed one case.

(c) **Œsophagoscopy.**—Œsophagoscopy has enabled several authors to diagnose this condition, notably Starck, Frase, and Ehrlich. As the œsophagoscope is passed, the mucous membrane tends to become plicated and the orifice of a traction diverticulum to be covered. The orifice is therefore seen more easily as the tube is withdrawn than during its introduction. A small depression is visible, the mucous membrane of which is red, chronically inflamed, and even ulcerated. It may be smooth or rough, and is usually very vascular. The orifice of the sac rarely dilates on respiratory movements, but may be seen to vary if the examination is performed without an anæsthetic, by making the patient swallow.

In order to confirm the diagnosis the examination may have to be repeated.

TREATMENT

There is virtually no treatment, as the diverticula are rarely recognized, and even if they are actually diagnosed all that is needed is occasional lavage of the œsophagus and careful attention to diet, chewing, and swallowing, to prevent their size from increasing.

B. PRESSURE DIVERTICULA

Whilst diverticula may arise in any part of the œsophagus, each variety shows a tendency to develop in a certain region, and below the upper end of the organ diverticula formed by pressure from within occur very rarely.

PATHOLOGY

The ætiology of the condition is obscure, but certain associated anatomical and pathological factors appear to exercise some influence upon their formation. The following classification of the varieties that have been recorded may be adopted:

- (1) Pressure-traction Diverticula.
- (2) Simple Pressure or Pulsion Diverticula.
- (3) Diverticula arising above a stenosis.

(1) **PRESSURE-TRACTION DIVERTICULA.**—Diverticula of this variety are those most frequently encountered, although by no means common. As the term applied indicates, they represent a further stage in the development of simple traction-diverticula. In the consideration of the latter it was shown that they are associated with glands or cicatricial tissues adherent to the œsophageal wall; hence they occur mainly in the regions of that portion of the œsophagus which is crossed by the left bronchus; and the term “epi-bronchial” is frequently applied to them.

Although the direction taken by the diverticulum is almost always horizontal or even obliquely upwards, and consequently not favourable for the entrance of particles of food, in some instances this actually does take place, and the sac enlarges through the pressure exerted within its lumen. The adjacent adhesions, however, limit the size of the diverticulum, the capacity of which rarely exceeds 5 c.cms. (See report of case below, p. 129.)

(2) **SIMPLE PRESSURE OR PULSION DIVERTICULA.**—Whilst corresponding in structure and development to the hypopharyngeal diverticula, but occurring at a lower level, these diverticula never arise from the posterior wall of the œsophagus. The site of election for their formation is one of the lateral walls—usually the left—a short distance above the diaphragm (hence the term “epiphrenic” often applied), a herniation of the mucosa taking place through the muscle fibres of the œsophageal wall. Zenker and Ziemssen, in 1877, denied the occurrence of diverticula of this character from the œsophagus proper, but a number of well-authenticated cases, amounting to nearly 100, has now been recorded, and doubt no longer exists. Of the theories advanced to explain the mode of formation of true pressure diverticula may be instanced that of Brosch, who suggests that the point of origin is one of the minute foramina for the transmission of vessels and nerves (cf. Diverticulosis of the Colon). Other observers consider that the condition represents a reversion to a more primitive type, analogy being suggested with Luschka’s “Vormagen,” or fore-stomach, present in certain of the lower animals; in these, the longitudinal muscle fibres of the œsophageal wall in its lower third separate into well-defined bundles as they pass on to the stomach, and it is held that there is an inherent local weakness of the wall. The great rarity of diverticula in this region, however, appears to negative this view.

Incidence.—The condition is rather more common in men than in women, and is found in middle life or old age, as a rule, but a case has been recorded in a child of 3 by Kurz, and in one of 8 by Mayr.

(3) **DIVERTICULA ARISING ABOVE A STENOSIS.**—The formation of a diverticulum above a stenosis is most exceptional, as thickening and hypertrophy of the œsophageal walls above a stenosed portion almost invariably take place, reducing the possibility of diverticulum formation to a minimum, in spite of the greatly increased pressure of food exerted on the wall by the violent muscular con-

tractions. Nevertheless, 5 cases have been recorded (Judd, Stierlin, Milton Portis), and I now describe and illustrate a sixth, previously unpublished, case.

Patient was a male, aged 32, admitted to hospital complaining of indigestion and wasting. Previous illnesses : Influenza and bronchitis nearly every year for the last few years. Family history : Negative. History of present illness : At about the age of 14, patient began to suffer from "indigestion", which was characterized by vomiting immediately or within two or three hours after taking food, daily and sometimes several times a day. There was no history of swallowing a corrosive or foreign body. Ten months before admission he had a severe hæmatemesis, losing a large quantity of blood for four days, and some dark blood was passed per rectum. There had been a great deal of pain in the lower part of the chest, just after taking food. The patient had lost flesh, particularly during the last six months. He noticed that he got marked regurgitation after anything with a high flavour. He had suffered from constipation for the last year. On admission the patient was extremely emaciated. The abdomen was scaphoid ; nothing abnormal palpable. Some broncho-pneumonia at lower lobe of right lung ; old consolidation present at right apex. He was too ill to submit to X-ray examination or œsophagoscopy. Pathological report on vomit : Fluid was clear, with flakes of material resembling undigested milk. Chemically it was found to be devoid of free hydrochloric acid, pepsin or blood. There were traces of lactic and butyric acid, which probably resulted from bacterial action, as numerous large bacilli of the lactic acid variety were present.

For seven days the patient vomited all food, the vomitus gradually becoming blacker in colour. Pathological report : Colour of fluid a rusty brown, resembling coffee ; chemically it was not possible to determine the presence of free acid, but a marked quantity of blood was present. Rectal salines and glucose failed to improve his condition, which was too bad to allow of gastrostomy being performed, and he died on the ninth day in hospital.

Post mortem.—The body was very emaciated and ill-developed. On opening the peritoneal cavity the alimentary tract was seen to contain very little food. On examination of the stomach and intestines no morbid state was found beyond the existence of altered blood in the stomach and first portion of the duodenum. The kidneys were joined together below in a narrow and small horse-shoe form ; the ureters were separate, springing from the inner margin of each organ and coursing to the pelvis in front of the lower end of each organ. The other abdominal viscera were normal.

Thorax.—Caseous tuberculosis was present at the root of the right lung, the lower lobe of which was solid from the presence of tuberculous broncho-pneumonia. The upper lobe of this lung was replaced to a large extent by fibrotic tissue, the result in all probability of old phthisis.

The œsophagus was found to be enormously dilated and its walls thickened along its whole length to the cardiac orifice of the stomach, which was constricted ; the lumen of the œsophagus at the cardia would barely permit of the passage of a lead pencil. On the left side of the œsophagus, a little below the middle, a large pouch or diverticulum the size of a small orange was present. No adherent glands were found, and the condition was probably produced by intra-œsophageal pressure arising above the extreme stenosis of the cardia. The whole of the mucous membrane of the



FIG. 83.—Case of pressure diverticulum arising above a congenital stenosis in the region of the cardia. (Case described in text.) (Author's specimen now in Royal College of Surgeons Museum.)

œsophagus showed marked chronic and subacute œsophagitis, with multiple erosions and small ulcers (Fig. 83).

In all six cases the diverticulum was situated in the dilated and hypertrophied lower half of the œsophagus, the stenosis occurring at the cardia.

DIAGNOSIS

(1) **PRESSURE-TRACTION DIVERTICULA.**—As in the case of simple traction diverticula, no symptoms may result from the presence of the condition, which may be discovered only post mortem : local œsophagitis, however, may occur around the orifice of the pouch and cause spasm of the œsophagus, the patient then complaining of a slight degree of dysphagia. On **radioscopy**, the bismuth emulsion may be seen to enter a small horizontally directed pouch. On **œsophagoscopy**, the usual appearances associated with a traction diverticulum will be noted, together with a greater or less degree of local inflammation.

(2) **PRESSURE DIVERTICULA.**—The possibility of the occurrence of these diverticula rarely suggests itself in the examination of the elderly patients who present themselves with complaint of a sense of obstruction and of retrosternal discomfort lasting for several hours after food, owing to the relative frequency of malignant disease developing in the region of the cardia ; but the general health and appetite are usually good.

Radioscopy will be undertaken in order to determine the nature of the obstruction, and is the best means of diagnosis. In the case of a diverticulum, the bismuth emulsion will be seen in part to pass through the cardia, whilst part of it is diverted into a lateral, regular, well-defined and rounded pouch ; when this is filled the bismuth continues to pass through the cardia, its passage, however, being somewhat retarded by the pressure of the distended sac on the œsophageal lumen. On the patient making several deep inspirations, or by applying pressure to the epigastrium, the pouch may be seen to empty, the bismuth first rising to the orifice and then passing downwards. Otherwise two or three hours may elapse before the pouch empties.

Œsophagoscopy in these cases is particularly difficult, although certain observers—notably Starck, Kelling, and Bensaude—have been successful. It is not usually indicated, the X-ray findings generally making the diagnosis quite clear ; but it must be remembered that malignant disease may develop in such a diverticulum, as in a case of Edgren's, especially if the condition of chronic irritation of its walls is of long standing ; and the patient's failure to respond rapidly to the hygienic treatment instituted should be an indication for an endoscopic examination. In an uncomplicated case the mouth of the sac is seen to be large and in free communication with the œsophageal lumen, which itself is narrowed by the pressure exerted upon it by the diverticulum ; in appearance it closely resembles a hypopharyngeal diverticulum.

TREATMENT

(1) **PRESSURE-TRACTION DIVERTICULA.**—No direct local treatment is called for beyond the regulation of the patient's diet, which should consist of bland and oily substances, in order to prevent fermentation processes taking place in the diverticulum, and to allay local irritation and inflammation.

(2) **SIMPLE PRESSURE DIVERTICULA.**—Similarly in these cases the diet should be simple and contain abundance of fatty and oily substances, these preferably being given at the commencement of a meal. The patient should be instructed to eat slowly so that the sac will not fill readily. If it be of large size, daily lavage will be required to keep it empty as far as possible and to prevent food fermentation. If, in spite of care, the patient shows signs of failing nutrition, gastrostomy should be undertaken before actual inanition supervenes.

Operative procedures for removal of the diverticulum have been proposed, also for making an anastomosis between it and the stomach, but are not advised, owing both to the satisfactory results obtained by dietetic measures and to the patients usually being elderly and unfitted to undergo such extensive operations.

(3) **DIVERTICULA ARISING ABOVE STENOSIS.**—If such a condition should be diagnosed treatment must of course be directed to relieving the stenosis. This is performed, as indicated elsewhere, under direct œsophagoscopic vision by means of graduated bougies or olives, and should be continued until the cardia has become normal, when the dilated œsophagus and diverticulum will no longer give rise to symptoms (pp. 53 and 154).

CASE OF PRESSURE-TRACTION DIVERTICULUM

CASE.—Female, aged 72. Admitted to the Cancer Hospital on the 1st February 1928, under Mr. R. H. Jocelyn Swan, who very kindly asked me to undertake her investigation. She complained of glands in the neck which sometimes discharged, and of difficulty in swallowing. She could swallow fluids but had difficulty with solids. There was no pain in the throat or on attempting to swallow, but she had had an aching and sense of heaviness behind the upper part of the sternum for twelve months. On examination, she was a very thin frail woman, with marked kyphosis. In both triangles on both sides of the neck were many small glands, some of which were adherent and matted together, and at one place a small discharging sinus. Her Wassermann reaction was negative. Radioscopic examination showed some barium held up in the middle of the œsophagus at a point which was at first thought to be a stricture. The upper part of the œsophagus was dilated, and the middle portion showed spasmodic irregular contractions. The radiogram was first reported to show the appearance of a carcinoma, but closer examination showed what had been noted on radioscopy, namely, that a small pouch was present at about the middle of the thoracic œsophagus, situated towards the anterior wall. It appeared to hold 4 or 5 c.cms. of the emulsion. Just above this there was a second very small persistent opacity. Well above this level the postero-lateral wall of the œsophagus appeared to be adherent (see Fig. 84). I performed œsophagoscopy and found the mucous membrane of the œsophagus quite normal except for a small congested and depressed area just

below the bifurcation of the trachea. No evidence of new growth was found, and in spite of the kyphosis the stomach was reached. The passage of the instrument

entirely relieved her symptoms, and was supplemented only by belladonna for the relief of the spasms.

Comments.—This patient had definite tuberculous glands in the neck of many years' standing, and I have no doubt that she had tuberculous glands in the mediastinum with adhesions to the œsophagus, causing at least two traction diverticula. As I have pointed out, traction diverticula alone practically never give rise to symptoms, because the direction of the diverticulum is either horizontal or directed upwards. One of these traction diverticula had become a pressure-traction diverticulum. My explanation of this is as follows: With the development of kyphosis a relative dropping of the anterior part of the thorax must have occurred, drawing with it therefore the heart and glands in front of the œsophagus. Thus the apex of the traction diverticulum would come to lie at a lower level than its orifice and the food would tend to enter it. Hence a pressure-traction diverticulum would

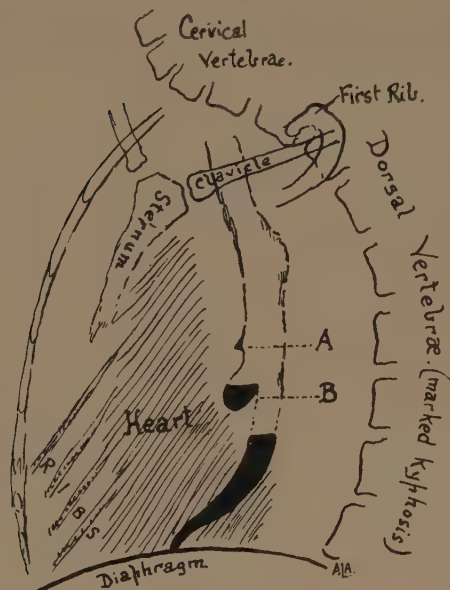


FIG. 84.—Diagram from radiogram of a case of pressure-traction diverticulum (described in the text) (B) with a small (?) traction diverticulum (A) above it.

result. Stagnation of food in it gave rise to a mild local œsophagitis quite sufficient to cause local spasms of the œsophageal wall, or, as I have pointed out elsewhere, of one or both of the two sphincters of the œsophagus.

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CHAPTER XII

CHRONIC ŒSOPHAGITIS ; PEPTIC ULCER ; SIMPLE TUMOURS ; VARICES ; GRANULOMATA

CHRONIC OBSTRUCTION IN THE LUMEN OF THE ŒSOPHAGUS

A FOREIGN body impacted in the lumen of the œsophagus may in very rare cases remain for a considerable time, and produce only slight obstruction to swallowing. But, later, a mild reaction occurs, and an insidious stricture begins to be formed in the wall of the canal.

The methods of diagnosing the presence of such a foreign body are similar to those described under the heading of acute œsophageal obstruction, and the treatment of the condition follows the lines already laid down. The complications and sequelæ are discussed in the succeeding section, as are also the effects of growths arising from the wall of this viscus.

CHRONIC OBSTRUCTION ARISING IN THE WALL OF THE ŒSOPHAGUS

1. CHRONIC NON-SPECIFIC ŒSOPHAGITIS

PATHOLOGY

Ætiology.—A chronic non-specific œsophagitis usually accompanies all organic lesions of the œsophagus, for example, cancer, fibrous stenosis, cardio-spasm, etc. It is occasionally secondary to acute œsophagitis, and may be due to a chronic irritation, as in heavy drinkers or smokers. It is also seen in patients who vomit hyperacid gastric secretions.

Pathological Anatomy.—The inflamed and thickened epithelium is covered with a layer of mucus due to the underlying catarrh. Hyperæmia, with dilated venules, is present, and superficial erosions, or even irregular, ragged ulcers, occur. Hypertrophy and infiltration of the muscular coat are commonly present.

DIAGNOSIS

The symptoms of chronic œsophagitis are usually superimposed upon those of the causal factor, and are frequently indistinguishable the one from the other. The greater the degree of œsophagitis the more marked is the discomfort during

swallowing, and the amount of pain is in direct proportion to the acuteness of the added œsophagitis. This causes considerable dysphagia and the expectoration of the mucoid secretions.

Accurate diagnosis is only to be confirmed by œsophagoscopy after a preliminary radioscopic examination.

TREATMENT

This is directed towards the removal of the cause of irritation, together with a bland liquid or semi-solid diet. The œsophagoscope may be utilized to wash out the œsophagus and to paint the inflamed or ulcerated foci with cocaine, lactic acid, or silver nitrate.

2. SIMPLE (PEPTIC) ULCER OF THE ŒSOPHAGUS

PATHOLOGY

Simple peptic ulcers of the œsophagus are extremely rare, only some thirty authentic cases having been recorded in the literature.

Ætiology.—Most of these are found only post mortem, and in some cases are alleged to be due to post-mortem change.

Their ætiology is very doubtful, but they usually occur in patients suffering from chronic vomiting.

Morbid Anatomy.—A small round ulcer, with a clear-cut edge and induration in proportion to the chronicity, occurs in the lower third of the œsophagus. A chronic gastric or duodenal ulcer may co-exist.

Complications.—Fatal hæmorrhage or perforation has occurred in the majority of cases, but cicatrization sometimes supervenes, giving rise to a fibrous stricture.

DIAGNOSIS

No symptoms may be present, but pain, dysphagia, and hæmorrhage occasionally occur. An accurate diagnosis is possible only by means of œsophagoscopy, and carcinoma must be carefully excluded by means of biopsy.

In all cases a Wassermann test for syphilis should be made.

TREATMENT

A concomitant gastric ulcer demands attention as well as the œsophageal lesion. Medical treatment consists of large doses of alkalis and a milk diet. Cocaine and morphine may be needed for the pain, and ice and adrenalin for the hæmorrhage. Surgical treatment is directed towards removal of the gastric ulcer, together with gastro-enterostomy, which reduces the acidity of the gastric juice. Simultaneously, gastrostomy should be performed in order that the œsophagus may be completely rested for some time.

The length of time during which a patient should be fed solely by means of gastrostomy will depend upon two factors. In the first place, the greater the

length of time that the œsophageal ulcer has been present the longer will be the time necessary for the œsophagus to have a complete rest. Secondly, the condition of the ulcer must be observed by the œsophagoscope from time to time, and gastrostomy feeding must be continued until all traces of ulceration have disappeared. The minimum time will be three months, and the maximum may be as long as eighteen months.

It is of course most important not to subject the patient to a long-continued gastrostomy for a syphilitic ulcer of the œsophagus ; and equally important not to perform a gastrostomy and tell the patient or his friends that he is about to die of cancer, when only a simple condition is present. The treatment of any stricture which may follow the healing of a peptic ulcer of the œsophagus is discussed later (p. 153).

3. SIMPLE TUMOURS

Simple tumours of the œsophagus occur very rarely, and of those which do exist only a small proportion give rise to œsophageal obstruction.

PATHOLOGY

Two varieties are described :

- (i.) Pedunculated tumours, or polypi.
- (ii.) Sessile tumours.

(i.) Polypi.

A polypus in the œsophagus may have arisen primarily from the pharynx, where its pedicle is attached, while the main mass of the tumour hangs downwards into the œsophagus. True œsophageal polyps arise from the anterior wall of the gullet, a short distance below its upper end. (Plate I. 1.) They seldom attain a size greater than that of a walnut, though a few much larger have been described. The pedicle may be either short or long ; the surface is smooth unless ulceration has occurred ; and it is usually regular, but occasionally lobulated. Microscopical examination shows that the tumour is either a fibroma, lipoma, myoma, or a simple mixed growth.

DIAGNOSIS

Intermittent and variable symptoms with painless and gradually increasing dysphagia make their appearance in a man of from sixty-eight to seventy-six years of age. Although rather old for the development of a carcinoma, great suspicion of this disease is naturally aroused. But the patient may complain of the sensation of a foreign body, and the tumour may, if it has a long pedicle, be displaced upwards as far as the glottis, or even into the mouth, by vomiting.

The diagnosis is established almost solely by means of œsophagoscopy, or, occasionally, laryngoscopy. In a few instances a large polyp has been felt on palpation of the cervical œsophagus. By means of the œsophagoscope a

portion or the whole of the tumour can be removed and its true histological nature revealed by the microscope. X-rays and the passage of bougies are of no definite diagnostic value in these cases, but are of assistance in excluding other conditions.

TREATMENT

This consists in extirpation of the tumour, which may be performed by avulsion, or better still, by cauterization, diathermy, or snaring.

In certain very large simple tumours in the region of the cardia gastrostomy may be required; whilst at the upper end, if removal by means of the œsophagoscope fails, cervical œsophagotomy may prove necessary.

(ii.) Sessile Tumours.

Sessile tumours, according to Guisez, are found only at autopsy. In one or two cases reported in the literature, however, dysphagia has been a symptom, especially when overgrowth of the epithelium, resulting in a papilloma, has taken place. These tumours are diagnosed and treated on the lines laid down for the pedunculated tumours.

The remaining varieties of sessile œsophageal tumours never give rise to œsophageal obstruction.

In all cases a simple tumour demands as radical a removal as possible, for, although there is no evidence that malignant changes supervene, it is always possible that they may do so.

4. VARICES OF THE CESOPHAGUS

Œsophageal obstruction may be produced by dilated and varicose veins occurring in the wall of the lower part of the œsophagus.

PATHOLOGY

Ætiology.—As has already been pointed out in dealing with the surgical anatomy of the œsophagus, the lower end of the canal is one of the regions in the body where a marked anastomosis occurs between the portal and systemic venous systems. The tributaries of the coronary, or left gastric, vein form an anastomotic venous network with the veins of the œsophagus which drain into the azygos vein and then into the caval system.

Any condition which causes an obstruction to the flow of blood through the liver—so-called portal hypertension—tends to produce a dilatation of veins at the various places where the two venous systems anastomose.

By far the most common cause of varices at the lower end of the œsophagus is cirrhosis of the liver, to which the names of alcoholic, portal, atrophic, and multilobular are commonly applied. This condition is usually due to alcoholism, and, in addition to the veins enlarging secondarily to the hepatic condition, alcohol is stated to exert a toxic action upon the actual veins of the

œsophagus, thereby rendering them more easily dilatable. The next most common variety of hepatic cirrhosis in which this œsophageal condition occurs is that due to syphilis. The important factor in the production of the portal hypertension is an obliterative endophlebitis. This directs the flow of blood towards the œsophageal veins, and hence varices in this position are sometimes found in patients who show little evidence of hepatic cirrhosis, and in whom there is no ascites.

Age and Sex.—The patients are usually middle-aged or elderly men.

Pathological Anatomy.—Varicose veins of the œsophagus are rarely found elsewhere than in the lower segment. They usually end abruptly at the level of the cardiac sphincter and extend upwards for a variable distance. Though of infrequent occurrence, a similar condition may be found on the gastric side.

On the œsophagus being opened, large tortuous cord-like structures are seen, which are almost black in colour, being distended with blood. Some local œsophagitis may be present, with superficial erosions of the mucosa. If death has occurred from hæmorrhage, actual ulceration of one or more of these dilated veins will be found. Apart from the small erosions lying over the veins, the intervening mucous membrane is usually normal, but may show an infiltration with small round cells and some organized fibrous tissue, with atrophy of the mucous membrane, and especially of the glandular elements. The local œsophagitis is due to two causes: (i.) the slight stagnation of food due to reflex spasm; (ii.) the atrophic condition of the mucous membrane, due to the fibrosis, and consequent impairment of the blood supply.

On section, the walls of the veins may show thickening and endophlebitis. If very dilated, the wall is thin and closely adherent to the mucous membrane. The erosions have sharply-cut edges; the severity of the bleeding which may occur is thus explained.

DIAGNOSIS

Symptomatology.—Varicose veins of the œsophagus reveal their presence by two distinct symptoms apart from those directly due to the hepatic cirrhosis:

- (1) Hæmorrhage.
- (2) Dysphagia.

The more common symptom is hæmatemesis, which may or may not be associated with dysphagia. The bleeding may occur from no apparent cause, or may accompany an attack of vomiting or follow the deglutition of large pieces of food. Large quantities of black unaltered blood make their appearance, but a few clots may be present. A certain proportion passes into the stomach and gives rise to melæna. In amount the hæmorrhage is usually considerable, and may cause syncope and secondary anæmia. It almost invariably recurs at intervals, and, at any time, may be fatal.

Dysphagia may occur without hæmatemesis ever having taken place, and is due to two factors. The first is the large size of the varices projecting into the lumen of the œsophagus; the second, the reflex spasm so often associated with the varicose condition and with the erosions of the œsophageal mucosa

which accompany it. This spasm has aptly been compared with the anal spasm occurring in patients suffering from hæmorrhoids.

Clinical Examination.—A careful general examination rarely fails to demonstrate the existence of cirrhosis of the liver, together with ascites and signs of a subcutaneous collateral circulation. It must be borne in mind, however, that œsophageal varices may occur without the presence of well-marked physical signs.

Melæna alone, even in cirrhotic subjects, is only rarely due to varices of the œsophagus, the bleeding usually taking place in some other portion of the gastro-intestinal tract.

Character of the regurgitated blood: it is not always easy to distinguish œsophagorrhagia from gastrorrhagia. In the latter the blood is blacker, altered, tends to be clotted, and usually gives positive tests for the presence of hydrochloric acid. Instead of the regurgitation of blood being effortless, as in œsophagorrhagia, it is accompanied by vomiting, and usually occurs in patients with well-marked gastric symptoms. Hæmoptysis consists of brighter blood with an admixture of mucus, no particles of food, is accompanied by coughing, and almost invariably by definite physical signs in the lungs.

Œsophagoscopy reveals tortuous dark-bluish patches, projecting above the normal level of the œsophageal mucosa, together with slight loss of the surface epithelium over them. (Plate I. K.) Careful clinical examination should have suggested their possible presence, and although at first sight they may simulate a carcinoma, careful inspection should lead to a correct diagnosis; portions must not be torn off for microscopical examination, or immediate death may ensue.

Œsophageal varices are perhaps the most dangerous manifestation of portal hypertension, and the prognosis is grave.

TREATMENT

In the chronic, quiescent stage, no local treatment is indicated, but general treatment directed towards the hepatic cirrhosis must be instituted and continued. This consists mainly of medical treatment in the form of purgatives and diuretics. When actual hæmorrhage occurs, the patient must be kept at rest, morphine given subcutaneously, and small smooth particles of ice swallowed whole. Small quantities of a mixture of equal parts of adrenalin and water are also given by the mouth, whilst sera, directed to increase the coagulability of the blood, *e.g.* hæmoplastin, are of some value. Considerable relief may follow the surgical operation of epiploxy, as in one of my cases.

CASE.—Male, aged 62. Admitted 1st October 1924. Complaint: Abdominal pains and swelling for six months; difficulty in swallowing, six months; three months ago "vomited" bright red blood, and has since then occasionally "vomited" immediately after food. Past history: Forty years ago had syphilis and was treated in the navy; thirty-three years ago was operated on at a London hospital for an abdominal swelling (? nature); six months ago was given intramuscular injections of

mercury. No family history of cancer or tuberculosis. Condition on admission: The abdomen was thin-walled and very distended, with signs of free fluid. A large mass projected from the epigastrium and right hypochondrium down to half an inch below the umbilicus. Wassermann reaction of blood negative. On œsophagoscopy large varicose veins were seen in lower three inches of œsophagus. (See Coloured Plate I., Fig. K.) On laparotomy, several pints of ascitic fluid were removed; the liver was much enlarged, irregular in shape, hard and somewhat rough. The great omentum was somewhat adherent to it and to a small area of the abdominal wall to the left of the mid-line. Apparently some form of Talma-Morrison operation had been performed. A small portion of the liver was removed, and under microscopic examination showed portal cirrhosis. The stomach and intestines were normal. A further degree of epiploxy was now performed, the peritoneum between the diaphragm and liver being excoriated, and as much as possible of the great omentum being sutured to the anterior abdominal wall. On 22nd November distension was rather less; patient able to walk about; difficulty in swallowing less. 26th November, patient discharged; swallowing gradually improving. Six weeks later no signs of free fluid were present, and he said his swallowing was normal, but refused further œsophagoscopy and has since been lost sight of.

5. THE GRANULOMATA

The granulomata which may affect the œsophagus are: (1) Tuberculosis; (2) Syphilis; (3) Actinomycosis.

1. Tuberculosis of the Œsophagus.

PATHOLOGY

Ætiology.—Obstruction of the œsophagus due to tuberculous infection is extremely rare. It occurs only in patients suffering from pulmonary tuberculosis, and most commonly affects adult males. It may be due to—

(i.) A spread of tuberculous ulceration of the pharynx.

(ii.) Infection by swallowed sputum.

(iii.) Invasion of the œsophagus from without.

(i.) Tuberculosis of the œsophagus has been recorded as a direct extension from buccal, pharyngeal, and laryngeal tuberculous ulcerations.

(ii.) Infection by means of the sputum very rarely occurs, as in ordinary cases it is rapidly swallowed and not arrested in the œsophagus. If, however, a previous ulceration or stricture of the œsophagus is present, sufficient delay of the bacillus-carrying material occurs, and infection may take place.

(iii.) The commonest method of infection of the œsophagus is from without, either through the blood or the lymphatic system, or from a caseating tracheo-bronchial gland. An abscess from tuberculous spinal caries may become adherent to the œsophagus, and may perforate this organ.

Morbid Anatomy.—On account of the frequency with which this disease is produced by neighbouring infected lymphatic glands, the ulceration is more commonly found in the middle third of the œsophagus, and may be single or multiple.

The ulcer may be small or several inches in length, and involve a varying degree of the circumference of the organ. In main direction, however, it lies in the vertical axis of the œsophagus. The edge is irregular, frequently bluish, and undermined in parts, while in others projections occur. In colour it is greyish, and small tubercles, which may show caseation, are scattered over its surface. The ulcerated area is surrounded by more or less inflammation and induration. One or more of the layers of the œsophagus may be affected, and considerable local thickening of the wall occurs, giving rise to rigidity and spasm.

A more stenosing type may occur, in which the œsophageal lumen becomes narrowed, or even obliterated, for a considerable distance. Dilatation of the organ occurs above the level of the stricture.

The wall of the œsophagus may perforate anteriorly, either into the local glands or into an air-passage, a pleural cavity, or even the aorta. Associated tuberculous lesions are always well marked.

DIAGNOSIS

Symptomatology.—In cases where a caseous gland becomes adherent to the wall of the œsophagus, but actual involvement of the mucosa does not develop and perforation fails to occur, the whole condition may remain latent and only be found post mortem.

The other varieties give rise to sudden dysphagia, with or without pain on swallowing, in patients suffering from pulmonary tuberculosis. Paroxysmal attacks of spasm make their appearance and are associated with regurgitation of food. The spasm may be overcome, in the early stages, by the use of a local anæsthetic. Later, when organic stenosis is present, the dysphagia becomes progressive, and the case resembles one of fibrous stricture.

X-ray Examination.—Radioscopy should first be used in order accurately to determine the level of the lesion and to discover any evidence of glandular enlargement.

Œsophagoscopy Examination.—In order to make quite certain of the diagnosis, œsophagoscopy is essential in most cases. The appearance of the ulcer is usually quite characteristic (Plate I. L and M), or, if it is not, a portion of its edge may be removed for microscopical examination.

TREATMENT

As it is essential that every patient with this lesion be fed as well as possible, local treatment of the disease is essential.

Instillations of cocaine or novocain before meals help to diminish both pain and spasm, and are supplemented by atropine and bromides.

Local treatment of the ulcer with a 5 per cent solution of silver nitrate, 20 per cent lactic acid, or iodoform powder, is very helpful. If stenosis has made its appearance, gradual and progressive dilatation is demanded; if this is impossible gastrostomy may be called for. On account of the great care which is necessary, bougies should always be passed under the control of the vision.

CASE.—Patient: Female, aged 24. Complaint: Pain on swallowing “as if food passed over a big sore”. History of present illness: After influenza, six months ago, patient was left with pain in right chest, which was relieved by strapping chest. Two months ago noticed pain on swallowing, and choking sensation in throat. Clinical examination: Signs of fibrosis at apex of right lung, with a few fine crepitations. Sputum contained no tubercle bacilli, but they were present in the regurgitated material on one occasion. X-ray examination showed a stricture of the œsophagus behind the manubrium sterni. The œsophagus was dilated above and showed three well-marked traction diverticula, the main course of each being directed obliquely upwards with the mouth at a lower level than the apex. (Fig. 85.)

Œsophagoscopy revealed a typical tuberculous ulceration. (Plate I. m.)

Bougies were passed under direct vision over a period of six weeks, and the patient went home much improved; she was given colossal sulphur by the mouth and improved further still.

She has not been to the hospital for $6\frac{1}{2}$ years, but writes to say that she is well, with only occasional slight difficulty in swallowing.

The radiogram is of interest in that it shows not only the tuberculous stricture and the dilatation of the œsophagus above this, but also three traction diverticula produced above the level of the actual ulceration through adhesion of other glands to the wall of the œsophagus.



FIG. 85.—Radiogram of a case of tuberculous stricture of the œsophagus (described in the text) and showing traction diverticula.

2. Syphilis of the Œsophagus.

PATHOLOGY

Ætiology.—Syphilis of the œsophagus occurs rarely in the congenital form of the disease; more commonly, in the so-called “secondary” stage, when it may give rise to an œsophagitis, manifested by dysphagia without any special characters, and with other obvious signs of the disease present. The condition rapidly responds to appropriate treatment.

During the so-called " tertiary " period syphilis of the œsophagus is still less infrequent, and in these cases takes the form of localized gummata.

Pathological Anatomy.—The gumma usually arises in the upper third of the canal, and on rupture produces a typical gummatous ulcer, with a clearly-cut edge and an unhealthy yellow base. There is considerable local induration, which is the main cause of the obstruction to the lumen. Leukoplakic patches may occur in the neighbourhood ; some local non-specific œsophagitis may be present, together with a little dilatation of the wall above the level of the lesion.

DIAGNOSIS

The symptoms are those of painless dysphagia, together with those of any other syphilitic lesion which may co-exist. If, however, any pharyngeal lesion is present, painful dysphagia occurs, together with some local spasm and regurgitation. When stenosis takes place there is nothing to distinguish this from a simple stricture, except direct local examination. The general examination of the patient will frequently reveal that he is suffering from syphilis, whatever the nature of the œsophageal lesion may be. Especial attention is to be paid to the mouth and throat, as signs of leukoplakia of the tongue and inner side of the cheek are rarely absent in long-standing cases. Scars are often found on the legs, and bilateral enlargement of the epitrochlear lymphatic glands, with no local condition to account for it, is always present.

Radioscopy should be employed in order to exclude the presence of an aneurysm, and to determine the level of the lesion.

Œsophagoscopy should next be resorted to, and great difficulty may be met with in making a purely visual diagnosis. This is especially so in the non-ulcerated variety of gumma, which closely simulates an infiltrating carcinoma. An actual ulcer is more readily diagnosed, and a portion removed for microscopical examination may reveal the true nature of the disease. The diagnostician must not be led astray by a negative Wassermann reaction of the blood, which is given by a very large proportion of sufferers from tertiary syphilis. The pathological examination of the cerebro-spinal fluid will, however, almost invariably confirm the clinical diagnosis of syphilis in this stage. On the other hand, a positive Wassermann reaction must not be taken to indicate that the condition is non-malignant, and therefore biopsy must always be performed. If in a doubtful case this fails to prove suspected malignant disease, it should be repeated. After two or more microscopic examinations have failed to reveal the true nature of the lesion, syphilis is to be strongly suspected. The diagnosis is usually confirmed by a course of appropriate treatment.

TREATMENT

Treatment is undertaken along two lines :

- (1) Antisyphilitic treatment.
- (2) Œsophageal treatment in order to combat the actual or potential stenosis.

(1) In primary or secondary syphilis, arsenic is administered intravenously for eight weeks, provided it has not been used in large quantities previously in the same patient. If it has, then only a shorter course of arsenic should be given. The dose varies from 0.45 to 0.6 gram in the female, and from 0.6 to 0.9 gram in the male, given at weekly intervals. At the same time as the arsenical injection, an intramuscular injection of mercurial cream, or bismuth, is given. At about the middle, and at the end of this course of treatment, an intramuscular injection of 0.25 gram of contramine should be given. After the last injection of contramine, the patient is allowed four weeks' rest from injections, and given potassium iodide gr. 5 in plenty of water three times a day by the mouth. After this, intramuscular injections should be recommenced, and continued once a week for eight weeks. They may consist of either 1 grain of mercury as a mercurial cream given each week, or 0.2 gram of an oily suspension of bismuth. By far the best preparation of bismuth in my experience is iodo-bismuthate of quinine (Fraisé), and this may be used with benefit alternately with the injections of mercury. After eight injections the patient is given four weeks' treatment by medicine—either potassium iodide as before, or colossal sulphur, 1 drachm three times a day; then eight weeks on a heavy metal and four weeks on a non-metal, and so on. The arsenical treatment should not be repeated.

In cases of secondary syphilis this treatment should be continued for at least three years, and no notice whatever need be taken of the Wassermann reaction, whether positive or negative, during this time.

In tertiary syphilis arsenic may be used, but its effect is not so good as in the early stages of the disease, and in my experience it is inferior to bismuth given as iodo-bismuthate of quinine. In tertiary and congenital lesions I strongly advise continuing injections of bismuth for at least four years, with four weeks' rest after each two months' injections; or alternate courses of injections may consist of bismuth for one course, mercury for the next, and so on.

2. Œsophageal Treatment.—Every healed and healing gumma of the œsophagus is accompanied by fibrosis and contraction; therefore the œsophagus must be subjected to frequent dilatations during the early months of the treatment, but later this need only be done at rare intervals, in order to be quite sure that no further active contraction is taking place. In the first instance, it should be done under direct vision, and if no contra-indication, such as excessive dilatation or diverticulum, is present, may subsequently be performed blindly.

I have had 2 cases of syphilis of the œsophagus under my care.

REPORT OF TWO CASES OF SYPHILIS OF THE ŒSOPHAGUS

CASE 1.—Female, I. T., aged 48. First attended at the Cancer Hospital, London, on the 30th June 1925, under Mr. Percival P. Cole, who kindly allowed me to undertake the investigation and treatment of the case. This patient first noticed difficulty in swallowing in December 1923, when she began to get occasional attacks of choking

after taking solid food, and sometimes brought up food that had been swallowed. The symptoms became progressively worse until September 1924, when she could swallow only liquid. She said she was admitted to another hospital where the stricture was dilated. At that time the Wassermann reaction of her blood was positive and she was given a course of N.A.B. injections, after which the Wassermann was negative. She was then free of symptoms until two months before I saw her at the Cancer Hospital, during which time the dysphagia had become progressively worse. On admission she could only take very soft solids. Solid food appeared to stop at the lower part of the neck. There was no history of any previous illness

or accident of any kind. She had one child aged nineteen years, and had had no miscarriages.

Physical Examination.—The patient was thin but not cachectic. She said she had lost a little weight. Colour good. Complete artificial dentures. Both epitrochlear glands were enlarged, but otherwise there were no clinical signs of any abnormality.

Radioscopy, July 2, 1925.—Patient could only swallow a teaspoonful or two of thin bismuth emulsion, which passed very slowly from the pharynx into the œsophagus. No other abnormality was detected.

Œsophagoscopy was performed on the 3rd July. Immediately the end of the, œsophagoscope had passed the cricopharyngeal sphincter a dense white fibrous stricture, almost completely obliterating the lumen of the œsophagus, was seen. A large patch of leukoplakia was present on the right posterior wall of the œsophagus at the level of the stricture. In view of the apparent thin-



FIG. 86.—Radiogram of a case of syphilitic stricture of the œsophagus immediately after swallowing radio-opaque fluid.

ness of the œsophagus, biopsy was considered inadvisable. A bougie was passed and the fibrous constriction seen to split. Three small bougies were left *in situ* for one hour. Four days later the patient was able to swallow easily.

The appearance as seen by the œsophagoscope before instrumentation is shown in Coloured Plate II., Fig. n (facing p. 152).

Bougies were passed, using gradually increasing sizes, every week or two. For the following nine months bougies were passed on an average once every two months. The appearance on 7th June 1926 is shown in Coloured Plate II., Fig. o. Her antisymphilitic treatment has been carried out on the lines indicated above, and is still being continued. A large bougie was passed twice in 1927 and met with no obstruction. The patient has had no difficulty in swallowing since the 7th July 1925, and œsophagoscopy in September 1927 revealed no abnormality.

CASE 2.—Male, V. T. B., aged 55. First attended the Cancer Hospital on the

15th July 1925, under the care of Mr. Ernest Miles, who very kindly delegated the case to me for investigation and treatment. The patient complained of difficulty in swallowing for three months, which had been gradually increasing. He brought up solid foods immediately, but fluids were retained unless swallowed quickly. He said he frequently brought up a great deal of "phlegm". He had been losing weight and was a little constipated. He had had attacks of vomiting lasting for two or three days every three or four months for six years, and had been treated by his doctor for "indigestion". He admitted having syphilis thirty years previously, when he was



FIG. 87.—Same case as Fig. 86 one hour later.

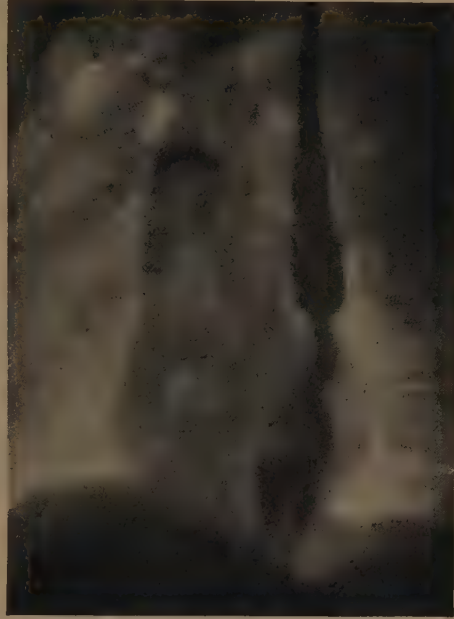


FIG. 88.—Same case as Figs. 86 and 87 taken after two years' treatment.

treated with one bottle of medicine only. There was no history of swallowing a corrosive or foreign body, or of any other serious illness.

On examination, he was well covered but somewhat anæmic. There was well-marked leukoplakia on the inner aspects of both cheeks, and the epitrochlear glands were enlarged. No other abnormality was detected on ordinary physical examination. His Wassermann reaction was found to be positive.

X-ray examination with a bismuth emulsion on the 15th July showed an irregular contraction of the œsophagus about four inches above the diaphragm, with some dilatation above (Figs. 86 and 87). Œsophagoscopy was performed on the 21st July, and the appearance was as shown in Coloured Plate II., Fig. P. The stenosis was thirteen inches from the incisor teeth, and would admit only a very small sound. The mucosa was very red and inflamed and bled easily. Patches of leukoplakia were seen on the inflamed surface, with a small area of actual ulceration, which was thought to be malignant, and a portion was removed for microscopy. The stenosis was dilated, and a Symonds' tube left *in situ*. This was vomited two days later.

The microscopic examination failed to show the presence of any malignancy and the patient improved with occasional dilatation.

Two months later œsophagoscopy was again performed, and a second portion of the suspected growth removed for biopsy. The appearances were so strongly suspicious of malignancy that two tubes, each of 50 milligrams of radium, were left *in situ* for six hours by means of an œsophageal catheter. However, the second microscopic examination was also negative and radium was abandoned; and anti-syphilitic treatment, together with regular dilatation by bougies, was commenced, and the patient improved rapidly. His antisymphilitic treatment has been continued ever since. Bougies were passed at first once a week, then once a fortnight, and then monthly, for nearly two years. The œsophagoscopic appearances as seen on the 14th July 1927 are shown in Coloured Plate II., Fig. Q, and a radiogram taken at the same time is shown in Fig. 88. The patient still has a bougie passed about once every three months, and has no trouble with swallowing unless he gulps very large pieces of food.

3. Actinomycosis of the Œsophagus.

Actinomycosis of the œsophagus has been known to occur, and is usually secondary to a bucco-pharyngeal lesion. It commences as a rule in the upper part of the œsophagus, and rapidly spreads to the adjacent structures. A large quantity of pus, amongst which are bands of sclerosed tissue, is present around the œsophagus. The pus contains the typical yellow "sulphur" granules. If the patient lives long enough fistulæ are apt to form.

DIAGNOSIS AND TREATMENT

The diagnosis is rarely made. Symptoms do not appear until six weeks after inoculation has taken place.

Slight progressive dysphagia, accompanied by pain, with regurgitation of the typical yellow granules of pus, makes its appearance.

The signs of infection of the neighbouring viscera are usually more in evidence than the œsophageal lesion.

If great care is taken in examining the pus the diagnosis may be made; or possibly a fragment of tissue removed by œsophagoscopy may reveal the nature of the disease.

If the condition is diagnosed early, good results may be obtained by means of very large doses—180 to 200 grains—of potassium iodide per day, but usually the disease is rapidly fatal.

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CHAPTER XIII

SIMPLE STRICTURES OF THE ŒSOPHAGUS

Definition.—Any permanent and progressive alteration of the wall of the œsophagus which is not the seat of neoplastic changes, but which gives rise to a diminution of the calibre of the œsophagus, is known as a simple stricture.

PATHOLOGY

ÆTIOLOGY.—Simple stricture of the œsophagus may be :

- (1) Inflammatory, *i.e.* secondary to inflammatory lesions of the wall of the œsophagus.
- (2) Traumatic, *i.e.* produced by fibrotic changes occurring in the wall of the œsophagus as a result of trauma arising from external causes, and upon which are usually superimposed inflammatory sequelæ.

1. **Inflammatory Strictures.**—Inflammation of the wall of the œsophagus as the main pathogenic factor in the production of a simple stricture is less frequent than the variety produced by extrinsic causes, such as the swallowing of caustic fluids, but it is advisable to retain this classification, as the different ætiology of the two conditions should be known and recognized.

The factors leading to the formation of inflammatory strictures are classified as follows :

- (a) Simple œsophagitis and simple ulcer.
- (b) Œsophagitis secondary to other lesions of the œsophagus, *e.g.* cardio-spasm.
- (c) Œsophagitis secondary to compression of the œsophagus occasioned extrinsically.
- (d) Œsophagitis occurring in the course of a general infection.

(a) *Simple Œsophagitis and Simple Ulcer.*—Acute œsophagitis, the ætiology of which has been discussed elsewhere (p. 66), may lead to an acute ulceration, or the œsophagitis may be chronic from the onset. The healing process may be accompanied by fibrosis and contraction, giving rise to an organic stricture.

(b) *Œsophagitis secondary to other Lesions of the Œsophagus.*—It is well known that cardio-spasm is frequently associated with a chronic œsophagitis ; the two conditions together combine to form a vicious circle. The end-results of this type of œsophagitis may be as stated above.

(c) *Œsophagitis secondary to Compression of the Œsophagus occasioned extrinsically, e.g. pressure by glands, dilated aorta, or mediastinal tumours, may be followed by ulceration and a cicatricial stricture.*

(d) *Œsophagitis occurring in the course of a General Infection.*—This variety of Œsophagitis, though rare, has occasionally been followed by stricture formation in cases of typhoid fever and diphtheria.

2. **Traumatic Strictures.**—By the term “Traumatic Strictures” is meant strictures arising from external causes. They may be :

(a) *Those due to the Swallowing of a Foreign Body.*—If the pressure of this is prolonged, or if trauma takes place during extraction, ulceration of the mucous membrane occurs, with subsequent contraction.

(b) *Those due to Caustic Fluids.*—This is the most frequent cause of the production of a simple stricture, and is due to the accidental swallowing of alkalis, usually sodium hydroxide, more rarely potassium hydroxide. Acids, e.g. sulphuric acid, are occasionally swallowed, as are also lysol, iodine, and perchloride of mercury. Many of the patients die, and those who recover almost invariably develop a stricture. The patients are usually young children.

The condition appears to be particularly frequent in America, where caustic soda, or “lye”, is kept as a common domestic cleansing agent, and large numbers of cases are reported annually.

(c) *Those due to swallowing Boiling Fluids.*—This condition is much rarer, but is usually due to children drinking from the mouth of a kettle or teapot containing boiling or almost boiling water or tea. Its incidence is said to be highest in this country. Its occurrence is almost unknown in adults.

(d) *Those due to Accidental Wounds of the Œsophagus.*—So often are cases of wounds of the Œsophagus accompanied by lesions of a fatal nature that only a small proportion live long enough to develop a stricture.

Guisez's figures of 185 cases of traumatic and fibrous stenoses are of interest in giving some idea of the relative frequency of the different varieties : those due to foreign bodies, 7 ; those due to hot liquids, 2 ; those due to war wounds, 5 ; while those due to caustic solutions were 169, representing over 90 per cent of the total.

PATHOLOGICAL ANATOMY.—The pathological anatomy of all simple strictures of whatever origin shows similar main characteristics, and the type described is that of the common variety due to caustics.

As with burns of any other surface, various degrees, depending upon the depth to which the process has extended, are noticeable. Small superficial burns, limited to the epithelium and corium, are quickly replaced by granulation tissue which epithelializes. They may not produce stenoses at all, but frequently an irregular contraction gives rise to crescentic or semi-diaphragmatic folds of mucous membrane. They produce, therefore, purely mucous strictures, and are frequently described as “membranous” strictures. Von Hacker termed them “Valve Strictures”. I prefer the term “Semilunar”.

When the submucous and muscular layers are involved, a more marked and extensive fibrosis occurs, giving rise to the so-called “callous” stricture. This

may be single or multiple, and either annular or cylindrical. Though denied by von Hacker, a complete obliteration of the lumen of the œsophagus may be produced, as shown by Horsley and Messenger Bradley. When multiple, the lowest callous stricture is usually the tightest.

Macroscopical and Histological Appearances.—(a) *At the level of the stricture* the wall of the œsophagus is markedly thickened and very hard in consistency. Cases have been recorded in which actual ossification occurred. On its inner surface, and on section, the dense mass of fibrous tissue is white in appearance and may be ulcerated. Adhesions to neighbouring organs are sometimes found, due to the round-celled infiltration and fibrous peri-œsophagitis.

(b) *Above the level of the stricture* a certain amount of hypertrophy and dilatation of the œsophageal wall proximal to the stricture occur. The degree of this is greater the lower the level of the stricture in the œsophagus, but although hypertrophy may be considerable, dilatation is not usually very marked.

The mucous membrane almost invariably shows signs of chronic inflammation, sometimes with actual ulceration. As the stricture develops, the mucous membrane is thrown into deep furrows, in which food is especially liable to stagnate. From the bottoms of these furrows pressure diverticula sometimes develop, and their presence explains the difficulties and dangers of catheterization.

(c) *Below the level of the stricture* the œsophagus and even the stomach are atrophied.

TYPES OF SIMPLE STRICTURE

- (1) Single stricture.
- (2) Multiple strictures.
- (3) Total stricture.
- (4) Complete occlusion.

1. **Single Stricture.**—A single stricture is present in some 60 per cent of the cases, and occurs at one of the normally narrowed levels in the œsophageal canal, viz. opposite the upper border of the manubrium sterni, behind the left bronchus, and at the hiatus œsophageus of the diaphragm. In children the œsophageal lumen is very small, and the main effect of the caustic is exerted upon its upper end, thus explaining the respiratory complications which often lead to a fatal termination before a stricture can develop. In adults, in whom normally a quantity of fluid passes almost instantly to the cardiac sphincter, it is immediately above this level that a stricture is produced. When the caustic reaches the lowest segment of the œsophagus the normal short interval before the relaxation of the sphincter is often considerably prolonged by reflex spasm; thus, depending on the amount of fluid swallowed, the greater or less is the length of the gullet subjected to the corrosive influence for an appreciable period of time. These facts give the explanation of the typical features of stricture occurring in the three portions of the œsophagus in adults: in the cervical region a single stricture is usually membranous in type; in the mid-thoracic

region it is more often a short annular stricture ; whilst in the lower thoracic region it is generally tubular.

2. **Multiple Strictures.**—These constitute 32 per cent of the cases (von Hacker). There are usually two, occasionally three, strictures occurring at the three points of narrowing referred to above. As a rule, the lowest stricture is the tightest, the intervening mucous membrane being normal and healthy.

3. **Total Stricture.**—Only rarely is the entire œsophagus converted into a cylindrical stricture. When the cicatricial process has produced such extensive changes the peri-œsophageal tissues are usually involved also, and adhesions to neighbouring organs are almost invariable.

4. **Complete Occlusion.**—In very rare instances the fibrosis is so extreme that a complete diaphragm is formed, entirely closing the lumen of the œsophagus.

PATHOLOGICAL COMPLICATIONS. Peri-œsophagitis.—This condition is produced either at the time of the initial burn, or, in advanced cases, as a result of inflammatory changes occurring in the œsophagus above the level of the stricture. It may cause actual suppuration, or a more chronic fibrosis may involve the recurrent laryngeal, vagus, and phrenic nerves.

A more acute peri-œsophagitis may produce a mediastinal abscess or an empyema. Occasionally ulceration extends into a large vessel, causing fatal hæmorrhage, whilst spread of infective processes to the lung causes pulmonary gangrene.

Perforation.—Perforation is the most serious complication. It may occur from previous ulceration or from impaction of a foreign body, *e.g.* a large food particle, above the stricture. Its commonest cause, however, is instrumentation and the formation of a false passage while dilatation is being attempted.

Pulmonary Tuberculosis.—The already debilitated and under-nourished subjects of stricture of the œsophagus are especially susceptible to tuberculosis.

PROGRESS AND PROGNOSIS.—Once sufficient damage has been caused, the progress of the stricture continues, and shows no tendency to spontaneous cure. The rapidity with which the contraction takes place depends upon the quantity and strength of the corrosive swallowed and the initial amount of damage done. Dysphagia is usually the first symptom, and, shortly after it has made its appearance, hunger, thirst, and wasting become apparent. During this progress acute symptoms may supervene, due to the impaction of too large a portion of food, causing aphagia. A similar condition sometimes occurs from secondary spasm of the œsophagus occasioned by the mural ulceration. The more rapidly a stricture develops the graver is the prognosis, whilst in a child, on the other hand, dilatation is assisted by the normal growth of the organ.

The outlook has been greatly improved since endoscopic examination and treatment were introduced.

DIAGNOSIS

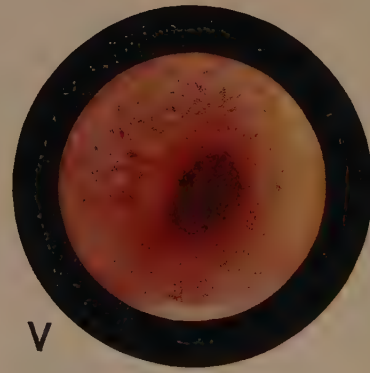
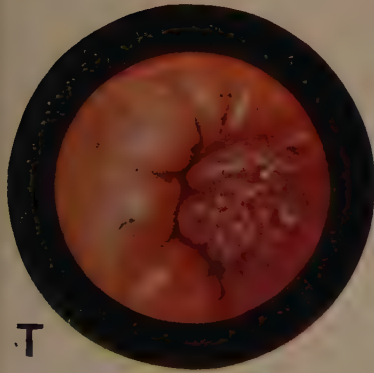
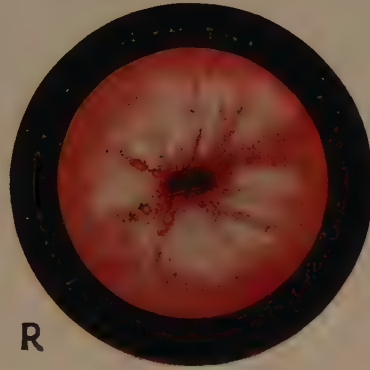
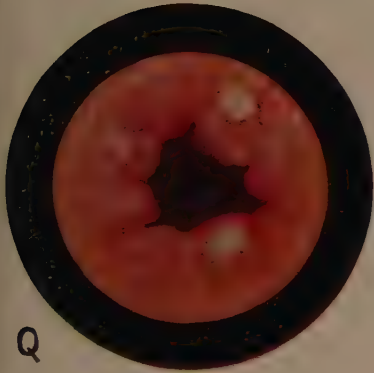
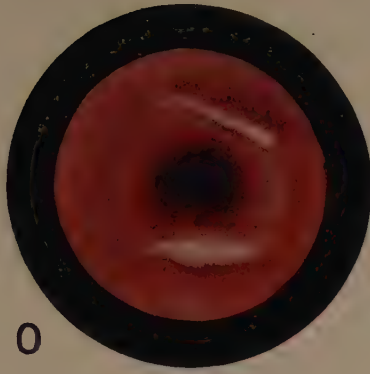
The diagnosis of simple stricture of the œsophagus must depend upon the clinical history, the symptomatology, and the examination of the patient.

PLATE II

APPEARANCES OF VARIOUS ABNORMAL CONDITIONS AS SEEN ON CESOPHAGOSCOPY

- FIG. N.—Syphilis of the œsophagus. Syphilitic stricture of the œsophagus in the cervical region, showing dense white fibrous stricture with the large patch of leukoplakia. Case described in the text. (P. 144.)
- FIG. O.—Same case as in Fig. N, eleven months later, after treatment by bouginage and routine antisyphilitic treatment. (P. 144.)
- FIG. P.—Syphilis of the œsophagus. Endoscopic appearance in the lower thoracic region, showing extensive gummatous infiltration with leukoplakic patches and an area of gummatous ulceration. The lumen is seen to be almost completely obliterated. (P. 145.)
- FIG. Q.—Same case as in Fig. P, two years later, after continuous antisyphilitic treatment and bouginage. Patches of leukoplakia still remain, but all ulceration and active inflammation have disappeared. (P. 146.)
- FIG. R.—Fibrous stricture. A case of cicatricial stenosis in the œsophagus in the lower cervical region three months after swallowing lysol. The size of the lumen may be gauged by the fact that on one occasion the patient developed complete obstruction by the impaction of a grape pip. (P. 152.)
- FIG. S.—Fibrous stricture. Endoscopic appearance of a case of fibrous or cicatricial stricture of the œsophagus in the thoracic region due to the swallowing of caustic potash. (P. 152.)
- FIG. T.—Carcinoma of the œsophagus. Scirrhus type, with commencing proliferation. (P. 184.)
- FIG. U.—Carcinoma of the œsophagus. Proliferative type. (P. 182.)
- FIG. V.—Carcinoma of the œsophagus. Same case as in Fig. U, shortly after commencement of treatment by diathermy. (P. 196.)
- FIG. W.—Carcinoma of the œsophagus. Polyoid type, with commencing infiltration. (P. 184.)
- FIG. X.—Carcinoma of the œsophagus. Ulcerative type. Middle third of the œsophagus. (P. 184.)
- FIG. Y.—Carcinoma of the œsophagus. Same case as in Fig. W, twenty-one months after treatment with radium, introduced by means of an œsophageal catheter. (See p. 193.) Note the whitened, flattened, and immobile scar tissue left as a result of the radium. The œsophagoscope is looking towards this area and therefore the lumen appears much smaller than was actually the case. The œsophagoscope could easily be passed beyond this level, as careful dilatation subsequent to the radium had been employed to prevent any stenosis, and the patient was quite free of any symptoms or signs of recurrence. Gastrostomy was not performed. In this and the previous cases the diagnosis of carcinoma was confirmed microscopically. (P. 195.)

PLATE II



bougie cannot be passed through it under direct vision, and the only satisfactory method is to use the Plummer silk-thread guide which the patient has swallowed twenty-four hours previously. While this is held taut, an attempt is made to pass sounds of various sizes threaded over the silk, until one which is of a suitable dimension is felt just to slip past the obstruction. The end of such a sound must always be passed into the stomach in order to make sure that no further stricture is present. By this means it is possible to estimate the site and degree of stenosis.

Apart from Plummer's method, a bougie should not be passed blindly, for if it is, the end of the sound may be held in a dilatation or pouch, or caught in one of the folds of mucous membrane, and any ungentle pushing is likely to produce a false passage with serious—if not fatal—results.

DIFFERENTIAL DIAGNOSIS.—As detailed elsewhere (see p. 22), the first line of investigation is directed towards excluding any possible cause of extrinsic compression of the œsophagus. The preliminary general and radioscopic examination of the patient is usually sufficient to do this.

Gastric conditions are sometimes misleading, especially in those cases in which a caustic has left the œsophagus unharmed and has exerted all its influence upon the stomach. Such cases will need a radioscopic examination of the stomach as well as of the œsophagus, and will also need gastroscopy in addition to œsophagoscopy.

Of true **œsophageal conditions**, those of spasm and cancer are the most difficult to differentiate from simple stricture. The typical history of having swallowed a caustic fluid is not always given by the patient, though in spasmodic conditions there is a long-standing history of dysphagia. It is in this type of case that an especially careful examination must be made, because the secondary inflammatory processes occurring above a spasmodic stricture may lead to a true organic stricture. The age of the patient and the rapidly progressive dysphagia, with no history of a burn or other trauma, usually allow a fairly certain diagnosis of cancer to be made.

When it has been ascertained that a simple stricture is present, the next step is to determine the exact type of the stricture. The different types are described on pp. 150 and 155.

TREATMENT

Dietetic.—The exact nature of the lesion having been ascertained, a dietetic régime should be commenced by the patient with a view to building up his general health and to diminishing the local œsophagitis and consequent spasm. Milk, therefore, is not advisable, as fermentation is thereby increased, but meat extracts and creamy extracts of potato, rice, cornflour, arrowroot, and the like are used, together with strained soups, eggs, cocoa, and ice-cream. Copious drinks of alkaline solutions must be taken after and between meals.

Medicinal.—Medicinal treatment is directed towards relief of spasm and diminution of the formation of fibrous tissue. The best antispasmodic is

morphine, 15 minims of a 1 per cent solution of which are given three times a day before meals. It may with advantage be combined with a similar quantity of $\frac{1}{4}$ per cent cocaine, and should not be employed for more than the first two or three weeks of treatment. In addition, between meals a mixture containing bromides and belladonna is found to be helpful.

The most potent drugs for the destruction or diminution of fibrous tissue are sulphur and iodine. Sulphur has been given in a variety of ways, the older and better-known preparations in this country being fibrolysin and thiosinamine. These have been supplanted by colossal sulphur, intramine, and contramine. The last of these is the most potent, and should be given intramuscularly, using 0.25 gram once a week for four to six weeks, or 0.125 gram twice a week for a similar period. The effect is increased if iodine is given by the mouth throughout the whole of this period. Iodine may be administered either as an aqueous solution of 5 grains of potassium iodide three times a day, or 40 minims of Lugol's solution three times a day, or 5 minims of tincture of iodine, allowed to stand in about two ounces of milk for twenty minutes, once or twice a day.

It is preferable that instrumentation be not performed for the first week or two during which the patient takes the sulphur and iodine preparations.

A stenosis due to syphilis demands antisypilitic treatment, in addition to surgical treatment.

Apart from such general lines of medical treatment, the essential treatment of all cases is surgical.

SURGICAL TREATMENT

The principal method is by Dilatation.

A number of other procedures are available, and the adoption of a particular one or more of these will depend upon the degree, number, and site of strictures present, the manner in which the stricture responds to dilatation, and the general condition of the patient.

Dilatation of a Simple Stricture of the Œsophagus.—This should always be performed under direct vision by means of the œsophagoscope; but if it is found to be impossible it may then be performed blindly.

In view of the fact that the opening of a simple stricture is almost always eccentric in position and some dilatation with cul-de-sac formation frequently occurs in the proximal segment of the œsophagus, it is very important always to use the œsophagoscope to facilitate the accurate passage of a dilating sound or bougie. Where possible, therefore, the operation is performed endoscopically and the observer is enabled to satisfy himself on a number of important points.

The condition of the mucous membrane above the stenosis is first studied; if any inflammation is present it forms a strong contra-indication to dilatation, which should not be performed until the œsophagitis improves. A further period of at least six or eight weeks must be allowed to elapse before dilatation is commenced, during which time sulphur and iodine may beneficially be used.

The presence of culs-de-sac is ascertained and the degree of difficulty likely to be encountered if blind dilatation has subsequently to be performed may be estimated.

The exact site of the orifice of the stricture may be seen and its induration and the degree of local spasm may be gauged ; the observer is then able to decide upon the best method whereby dilatation may be effected. If considerable spasm is present it may be overcome to a certain extent by means of the application of a few drops of a 10 per cent solution of cocaine with a very small quantity of adrenalin.

If more than one stricture is present and the first is large enough to see through, lower strictures can be seen and an exact outline of the future treatment that will be required may be determined.

The following types of stricture may be met with and demand varying methods of treatment :

- (1) A permeable and dilatable stricture.
- (2) A permeable but non-dilatable stricture.
- (3) A stricture non-permeable from above but permeable from the stomach.
- (4) A stricture which is entirely impermeable.

(1) In the case of a permeable and dilatable stricture the size of bougie which is first passed varies with the degree of stenosis. If the stricture is very tight an attempt must be made to pass a filiform bougie, and this should be left in for eight to ten hours, or even for a day or more ; nothing more is needed for the first sitting.

This procedure corresponds with that so frequently adopted in the male urethra under similar conditions.

Care is taken to fix the filiform sound in such a way that it cannot be swallowed or regurgitated. After the endoscope through which it has been passed has been withdrawn, the proximal end of the sound should be drawn through the patient's nose, for if it is left projecting from the mouth he is almost certain to bite through it. Tapes tied to it are fastened round the head or ear or attached to the skin by means of strapping.

A comparatively great increase in the size of the orifice of the stricture results from this simple procedure, and it is therefore a great mistake to endeavour actively to dilate a tight stenosis at the first sitting. If this is attempted there is a great risk of perforating the œsophagus ; bleeding and the further formation of scar tissue are bound to result, and a few days later the condition is worse than before. The presence of a filiform bougie for many hours causes a continuous gentle pressure, an absorption of fibrous tissue, and a relief of local spasm, and a few days later may be followed by the passage of a sound several sizes larger, and much more rapid dilatation results.

If the stricture is extremely tight it is advisable to get the patient to swallow a fine silk thread, as in Plummer's method, the day before dilatation is to be attempted, and then to utilize this to pass a filiform bougie over and to find the lumen of the œsophagus.

When a filiform bougie is in position a bougie of slightly larger size may

be screwed on to it, and the larger bougie then passes easily through the stricture and gradually dilates it.

Increasing sizes of bougies are used at intervals of one, two, or three days. Their sizes should be increased very gradually, and when the smaller grades are in use each is left in position for about half an hour ; but later, larger ones may be retained for twenty-four or forty-eight hours. This is continued until a sound of 20 mm. diameter can easily be passed.

Subsequently dilatation is needed only every two to four weeks, and then at gradually increasing intervals, until the surgeon is satisfied that no fibrous contraction is taking place.

Other methods have been devised, but none is so safe or so satisfactory as that of gradual dilatation.

Rapid dilatation with great force is brutal and dangerous and should never be employed.

With long and narrow strictures difficulty is experienced in maintaining the dilatation. For such cases laminaria bougies or laminaria tents as used by gynecologists may be placed in position under visual control and allowed to exert a continuous and gradually increasing pressure.

An alternative method of performing gradual dilatation is by means of a hollow rubber drainage tube closed at its distal end. The upper end is held taut by an attached stout thread, and a metal guide pushed into it causes elongation of the tubing until it is thin enough to pass through the stenosis. This it is now made to do under direct vision, and the guide is withdrawn ; shortening of the tube occurs and causes a continuous pressure on the stricture.

Guisez makes use of a small rubber tube with a small flange at each end.

If a gastrostomy opening is present, rubber tubing may be inserted in still another manner. First the patient swallows a stout piece of thread, which when it reaches the stomach is drawn out through the gastrostomy opening, the other end being retained outside the mouth. One end is firmly attached to a piece of rubber tubing which is pulled upon until the tubing is fine enough to pass the stricture, through which it is then drawn. When the rubber is allowed to relax, it exerts a continuous pressure only upon the stenosed portion or portions of the œsophagus.

(2) If, after the foregoing methods have been tried, dilatation cannot be performed on account of the extreme fibrosis of the stricture, the most satisfactory manner of dealing with it is by electrolysis. This may be linear or circular and should always be used under direct vision. A current of 15 milliamps. is applied, either to one edge of the stricture or all round it, by means of a metal olive or a ring attached to an olive. The conducting wire is carefully insulated so that it does not touch the œsophagoscopy tube. The other electrode is placed upon the patient's chest and when the olive is seen to be in position the current is turned on. The olive is kept gently moving in order that it shall not become adherent to the stricture. As the latter increases in size it may allow the whole olive to pass ; this is then of no further value, but must be replaced by a larger one.

At the same sitting gentle dilatation by means of soft bougies may follow, and it will then be found that the electrolysis has caused a great softening of the cicatricial tissue and has rendered dilatation by bougies much easier, thus making it sufficient to dilate only once in two or three weeks instead of more frequently.

(3) Strictures which are impermeable from above but permeable from below.

These are rare and are difficult to treat and demand a gastrostomy as soon as the condition is established. This allows rest to the œsophagus, permits feeding of the patient, and allows a retrograde œsophagoscopy to be performed, when the orifice which was quite invisible from above may be found. Even if retrograde œsophagoscopy fails to reveal the opening, the presence of a gastrostomy, accompanied by alkaline lavage of the œsophagus, causes a regression of the œsophagitis, and frequently after a few days' rest and lavage the spasm of the œsophagus at the level of the stricture is diminished to such an extent that the orifice now becomes visible either from above or from below.

If the orifice was not found by retrograde endoscopy at the time the gastrostomy was performed, a second attempt must be made a few days later, and in order that this may be possible the gastrostomy opening should be as near the cardia as possible,

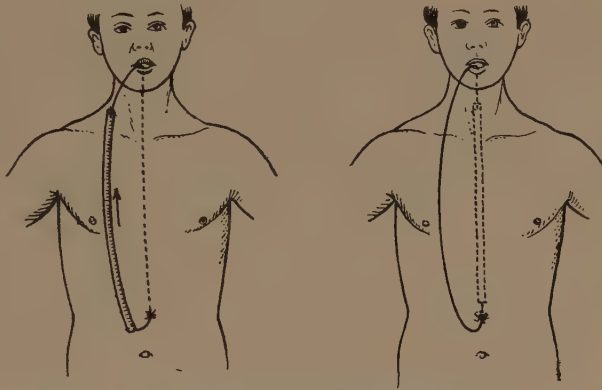


FIG. 89.—Simple stricture, congenital or acquired, of œsophagus treated by rubber tube.

and in such a way that no valve-like flap is formed which would impede the passage of the endoscope upwards towards the cardia. The most satisfactory form of gastrostomy is, I think, my modification of Witzel's method with the sloping groove directed from below upwards and to the right.

With a little practice and care in passing the instrument under direct vision along the lesser curvature, the cardia may be seen to open if the patient takes deep inspirations. Once the cardia is passed and the stenosis reached, the procedure in dealing with the stricture is exactly similar to that which is adopted when œsophagoscopy is performed from above. A filiform bougie is first passed and to it may be attached a silk thread which can be drawn upwards into the mouth. Each end of the thread is attached to the two ends of a fine piece of rubber tubing, and therefore a continuous or endless chain is present. By means of the thread, the tubing is pulled hard enough to render the diameter of the rubber small enough to pass the stenosis. When tension on it is relaxed its length is diminished and its diameter increased, and it then exerts continuous pressure on the stricture and causes further dilatation. The

rubber is left in position for an hour or two every day, and then by pulling upon the thread the rubber is displaced from the œsophagus and its place taken by the thread. Every few days the tubing must be replaced by one of larger calibre until sufficient dilatation is obtained (Fig. 89).

If the stenosis is found to be impermeable both from above and from below, Plummer's method of swallowing a silk thread must be tried again after any œsophagitis has subsided. This may lead to the detection of the previously invisible orifice.

If the opening is found, and does not yield to gradual dilatation, the most satisfactory method of dealing with it from below is by means of circular electrolysis.

(4) If the stricture, in spite of all attempts, is quite impermeable, recourse must be had to more drastic surgical operations. This is very rarely needed : of 185 cases treated by Guisez there were only 4 which were impermeable to dilatation methods.

The following operations have been utilized for dealing with this rare type of case :

- (1) External cervical œsophagotomy.
- (2) Thoracic œsophagotomy.
- (3) Cervical œsophagostomy.
- (4) Œsophagectomy.
- (5) Œsophago-gastrostomy.
- (6) Œsophago-jejuno-gastrostomy.

The majority of these operations are described at some length under the section dealing with the radical operations devised for the treatment of carcinoma of the œsophagus, and a brief indication alone in this situation will suffice.

1. **External cervical œsophagotomy** is performed in the cervical region either a short distance above the stricture so that it may be treated directly, or at the level of the stenosis so that a local section may be performed, with transverse suture of the vertical incision, after the fashion of a pyloroplasty. This suture is difficult because the operation is performed amidst dense fibrous tissue. Important points in the pre-, syn-, and post-operative treatment of these patients are given elsewhere (p. 116 and p. 198).

Through a cervical œsophagotomy an instrument may be passed and internal œsophagotomy performed.

2. **Thoracic œsophagotomy** is performed as described on pp. 201 *et seq.*

3. **Cervical œsophagostomy** has been employed in patients in whom it is impossible to dilate the stricture frequently enough, in order that they may be fed through the neck. This operation has been entirely superseded by gastrostomy.

4. **Œsophagectomy** has been performed in the cervical region and may be followed by autoplasty (see p. 200). Apart from cancer, its indications are extremely rare.

5. **Œsophago-gastrostomy** is described on pp. 209 *et seq.*

6. **Œsophago-jejuno-gastrostomy** is performed by isolating a loop of jejunum,

passing it under the skin of the thoracic wall and anastomosing it above to the upper end of the œsophagus, and below to the stomach. Twenty-two successful cases of this operation have been recorded.

Great care and patience are needed on the part of both patient and surgeon in the treatment of fibrous strictures of the œsophagus; according to von Hacker one-third die during treatment because of complications, usually peri-œsophagitis, making their appearance. Nevertheless, the lives of patients may be prolonged and made happier and more bearable by a careful clinician, who should leave no stone unturned to render the condition as satisfactory as it is possible to make it.

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CHAPTER XIV

CANCER OF THE ŒSOPHAGUS

INTRODUCTION.—Cancer is the most important disease of this organ, being present in one out of every two cases which present themselves with an œsophageal lesion. It is also found in one person in every twenty suffering from cancer, and has, up to the present, an almost unrivalled position amongst the malignant growths in producing a mortality of practically 100 per cent. In the whole of human history less than ten people have been cured of this disease.

TYPES.—There are two types of cancer of the œsophagus :

- I. Sarcoma, which is but rarely found.
- II. Carcinoma, which is by far the more common variety.

I. SARCOMA OF THE ŒSOPHAGUS

PATHOLOGY

Sarcoma of the œsophagus is a very rare disease, and I have only been able to find records of 38 cases in the literature.

It arises in the submucous layer of the œsophagus and is usually of the round or spindle celled variety. Growth spreads principally towards the œsophageal lumen, and may even become polypoid. It also, usually at a later date, invades the muscular wall, and may spread to and involve neighbouring structures.

Two distinct types are described :

- (i.) The localized or circumscribed variety, which shows little tendency to metastasis formation, and is relatively benign.
- (ii.) The diffuse type.

From the point of view of pathogenesis and the question of diagnosis and treatment, no distinction can be made between sarcoma and carcinoma.

II. CARCINOMA OF THE ŒSOPHAGUS

PATHOLOGY

Cancer of the œsophagus is notably a disease of men, usually occurring between the ages of forty and seventy, especially fifty-five to sixty. To every six or seven men affected the disease appears in only one woman.

A. PATHOGENESIS.—It is seldom that any predisposing factor is present in this type of case, though its preponderance in men has been ascribed by many

observers to the abuse of alcohol and tobacco. Lamy found that syphilis was present in one case in ten, which is no higher than in the general population, but it is interesting to note that a leukoplakic condition of the œsophageal mucosa frequently occurs in the neighbourhood of the carcinoma. This may be contrasted with lingual cancer, which is almost always preceded by syphilis, and rarely occurs without some local leukoplakia of syphilitic origin. Leukoplakia of the œsophagus, however, rarely owes its origin to syphilis, whereas in the tongue the converse holds true.

B. THEORIES OF THE CAUSES OF CANCER.—The various modern theories of the causes of cancer must be examined and discussed with reference to their possible bearing on the cause of this disease in the œsophagus.

1. Chronic Irritation.—At the present time the foremost theory of the cause of cancer is that of chronic irritation; such irritation may be produced in a variety of ways.

(a) Mechanical Irritation.—Cancer of the œsophagus occurs in the portions of this organ which are most constricted, and which are therefore subject to the greatest pressure or friction by food, viz. at the upper end, where a bolus normally is arrested for an instant if the opening of the sphincter in this position is delayed, as in the too rapid swallowing of food.

Narrowings of the lumen also occur at the level of the upper aperture of the thorax and behind the left bronchus, and the mucosa in these situations is therefore more liable to friction than that of the intervening portions. At the lower end there is always considerable delay, and it is at these levels that cancer is most prone to develop. The relative frequency of each will be discussed later. (See p. 163.)

(b) Thermal Irritation.—The question of heat also has its bearing upon the development of cancer of the œsophagus. It is frequently said that in China, where the men take their food when it is as hot as possible, the majority of growths of the œsophagus occur at the lower end, i.e. the position of longest delay. This delay, we know, must be much greater when the food is very hot, as the cardia does not open until the surface temperature of the bolus reaches that of the œsophageal wall. Amongst the women, on the other hand, who do not commence their meal until the men have finished, cancer of the œsophagus is almost unknown.

This may be compared with the Kangri cancer, which occurs in Kashmir, on

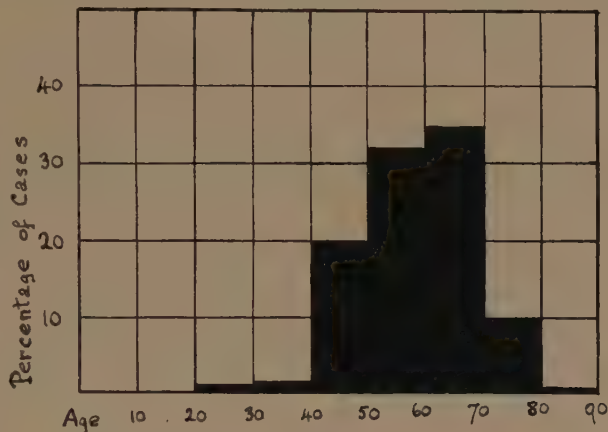


FIG. 90.—Table showing age-incidence of cancer of the œsophagus (in percentages).

the abdominal walls of natives who use a charcoal brazier close to the skin for warmth in cold weather. The antecedent burn is apparently the exciting cause.

It may be mentioned, however, that the frequency of œsophageal cancer in China is denied by some European surgeons who practise in that country, and that the alleged difference in temperature of the food of men and women there is regarded as a myth.

(c) *Irritation due to Chronic Infection.*—In the presence of teeth, and especially carious teeth, the mouth, pharynx, and œsophagus contain the most virulent bacteria found in the human body, and it is possible that they cause an area of inflammation, or local œsophagitis, which gives rise to a precancerous, and ultimately a cancerous, condition. In support of this, we may note that a gastric carcinoma often follows a previous gastric ulcer, which is held to be of bacterial origin. Carcinoma of the gall-bladder is also frequently preceded by cholecystitis, which was originally bacterial in origin. Similarly, cancer of the tongue is almost invariably preceded, as stated above, by a syphilitic lesion, upon which a chronic pyogenic infection is superimposed.

2. *Theory of Physiological Regression.*—This theory has been advanced to explain the great frequency of cancer of the breast, uterus, and ovary, and it is possible that some similar fate overcomes the glands of the œsophageal mucosa, which may then become the seat of malignant growth.

At the upper end of the œsophagus a large number of subjects show a small islet of mucous membrane which is microscopically indistinguishable from normal gastric mucosa. It has been suggested that cancer in this position arises as the result of regressive changes commencing in these aberrant cells.

3. *Heredity.*—Heredity alone would never appear to be a sufficient reason for the development of any type of cancer, but it is to be regarded only as a general predisposition. It has been shown that the progeny of mice from a cancerous ancestry are more prone to be attacked than that from a non-cancerous one. In only one of 120 consecutive cases of cancer of the œsophagus admitted to the Cancer Hospital, London, had a parent died of the disease in a similar situation.

4. *The Embryonic Hypothesis.*—The embryonic hypothesis of Cohnheim, which supposes the existence of latent embryonic rudiments, and the various cell and parasitic theories do not warrant any attention here, as they have no special bearing upon the œsophagus over and above any other area of the body.

5. *The Post-spasmodic Theory.*—An important contribution to the ætiology of cancer of the œsophagus is the series of facts carefully observed by Guisez. He states that a very large proportion of his cases—in fact, two-thirds—have at an early date after, or even immediately upon the receipt of, a severe mental or emotional shock, commenced to suffer from the symptoms of œsophageal obstruction. His explanation is that a spasm occurs reflexly of the cardiac sphincter or of the sphincter of the upper end, which at first is intermittent, thereby causing some delay in the passage of food. This causes a mild œsophagitis, possibly with the formation of leukoplakia immediately proximal to the obstruction, which therefore now ceases to be intermittent and becomes a continuous, true, organic stenosis. The symptoms become progressively more

severe, and the inflamed area readily undergoes malignant changes. A history of severe shock has been given in many of my cases.

The relative frequency with which the post-cricoid growth occurs in women, who, on account of their more neurotic tendencies, are more apt to develop spasm of the upper end of the œsophagus and globus hystericus than are men, lends some support to this theory. Men, on the other hand, for some reason which is at present obscure, more commonly experience spasm of the cardiac sphincter than of the superior sphincter of the œsophagus, and, if they are affected by malignant growth, this more commonly occurs in the former situation.

Guisez also records cases of patients who have been under observation and treatment for œsophageal spasm and œsophagitis for a number of years, and who, finding that their dysphagia has become suddenly worse, present themselves for œsophagoscopy examination, and are found to have developed epitheliomatous changes. (See discussion on p. 75.)

MORBID ANATOMY

Carcinoma of the œsophagus may be primary or secondary.

Secondary carcinoma of the œsophagus is due to extension from neighbouring organs, commonly from the pharynx, larynx, or thyroid gland, and is dealt with in the section on Extrinsic Causes of Œsophageal Obstruction (p. 93).

Primary carcinoma of the œsophagus may occur at any level, but is usually found at either extremity or in the narrowed portion where the œsophageal lumen is diminished by pressure of the left bronchus. The relative frequency with which carcinoma arises in these three situations is a matter of some dispute. The difficulty is to distinguish a post-cricoid growth arising in the hypopharynx from a so-called post-cricoid growth commencing primarily in the œsophagus. Similarly at the cardia confusion arises as to whether a growth in this situation is primarily œsophageal or gastric in origin. The cases in which no doubt whatever occurs are those developing in the middle third, and many observers maintain that this is the area most commonly the site of origin of cancer of the œsophagus. The following table shows the percentages of a number of writers' observations :

	<i>Upper.</i>	<i>Middle.</i>	<i>Lower.</i>
Mackenzie	13	50	37
Rawling	10	80	10
Binnie	16	32	52
Guisez	34	46	20
Krause	12	40	48
Lamy	10	36	54
Author's Series . . .	29	46	25
Mean	18	47	35

From the above table it will be seen that the middle portion of the œsophagus is most commonly affected with carcinoma, the lower portion being next in order of frequency, and lastly the upper end, these being roughly in the proportion of 3 : 2 : 1.

This table does not include the post-cricoid growths. If these are included the relative frequency with which the upper end of the œsophagus is affected becomes greatly increased and approximates much more closely to that of the cardiac end.

Cancer of the œsophagus usually arises as a single tumour, although one or two cases are recorded in which apparently multiple primary tumours have developed. These are probably cases in which spread *via* the deep lymphatic channels has occurred.

It is very doubtful if spread by physiological propulsion ever occurs in either the œsophagus or the pharynx.

Occasional cases are recorded in which a primary growth has arisen in the œsophagus and a second primary growth has made its appearance in some other organ of the body. This, however, does not occur as frequently as would be expected when the high incidence of carcinoma in human beings is considered in conjunction with the ordinary laws of chance.

At the time of the death of the patient the tumour generally occupies from two to three inches of the long axis of the œsophagus. It may be situated on one aspect of its wall, but most frequently an annular growth is found, analogous, therefore, to conditions found in the colon. The entire œsophagus is rarely affected in a manner similar to the carcinomatous "leather-bottle" stomach.

TYPES

Three pathological types occur :

- (1) The vegetative, proliferative, or polypoid.
- (2) The infiltrating or soft ulcerative.
- (3) The hard scirrhus.

Type I.—The proliferations of this type of growth form a tumour somewhat comparable to the "cauliflower" growth of the colon, and are seen projecting into the lumen with a lobulated or villous appearance. The surface is friable, bleeds easily, and may be actually ulcerated. The vegetations tend to grow upwards, where the œsophagus may be dilated, whilst below they are smaller and whiter in colour, owing to the comparative narrowness of the tube and to their impaired blood supply, on account of the spasm and fibrosis occurring in the wall of the organ. Macroscopically, the wall, on section, is seen to be thickened and infiltrated with growth, and its layers indistinguishable from each other.

Type II.—The soft infiltrating variety causes much thickening of the wall, which, on section, is of a somewhat pink and grey colour. The characters of this type are those of an epitheliomatous ulcer: it has a firm, raised, everted edge, which is very irregular in outline, but nevertheless clearly

demarcated from the adjacent mucosa. Its central or ulcerated portion is hollowed out, and in this part the thickness of the wall of the œsophagus may be very much diminished. It is in this type that actual perforation frequently occurs. Its surface has the appearance of very unhealthy granulations and may be found to undermine the edge in some places. At some parts the appearance may not be that of true eversion, but rather of the rolled-over edge so typical of a rodent ulcer; it occasionally happens that the macroscopic appearances do not lead to a certain diagnosis of cancer being made, and that only with the microscope is the true nature of the lesion discovered.

Type III.—The hard scirrhus variety occurs most commonly at the lower end of the œsophagus. It is frequently annular and gives a hard grating sensation on being cut with a knife. The section is then seen to be relatively dry, with a considerable area of fibrosis extending around it, and consequent thickening of the wall of the gullet.

MORBID HISTOLOGY

The majority of new growths of the œsophagus are typical squamous-celled carcinomata, sometimes showing marked keratinization and numerous "cell-nests". In a smaller number of instances the growth is of the basal-celled type.

(1) The **proliferative or polypoid variety** shows considerable hyperplasia of the epithelium in an irregular manner, together with infiltrating growth invading the base and the adjacent thickened submucous layers, and often extending to the muscular coat. The free surface of the growth is the site of ulcerative and degenerative changes.

(2) The **ulcerative variety** shows the usual features of an epitheliomatous ulcer, the edges consisting of heaped-up cells of new growth; the floor, of the ulcerated submucosa and deeper layers, with permeation of the lymphatics by the neoplastic cells. An increase of fibrous tissue around the ulcerated area is frequently to be seen.

(3) The **scirrhus or infiltrating variety** is characterized by the amount and density of its stroma, the fibres of which are separated by columns of epithelial cells penetrating widely and deeply. Surface growth is slight or absent.

Exceptional types are recorded from time to time, the chief of these being of glandular origin, arising from the islets of cells which occur in the œsophageal epithelium similar to those of the gastric mucosa (Schafer). Chavannaz has described a columnar-celled carcinoma, with ramifications presenting a glandular appearance. Herxheimer has recorded a case of co-existent carcinoma and sarcoma, and Pratt and Lockyer one of carcinoma associated with lymphosarcoma. From a histological point of view, examples of these are of interest, although of slight importance from the clinical standpoint.

Condition of the Remainder of the Œsophageal Wall.—The œsophageal wall below a carcinoma is not affected except when the growth has originated in a

patient with a previous spasm or œsophagitis, and also in those where spread has occurred along the deep lymphatic channels.

Above the level of the lesion a greater or less degree of œsophagitis is almost invariably found; the mucous membrane is softened, hyperæmic, and may be ulcerated. A condition also occurs known as "retro-dilatation", that is, dilatation of the œsophagus above the level of the growth. This is necessarily of a mild degree on account of the rapidity with which the obstruction develops. Hartmann has suggested that this dilatation is only apparent, the real cause of the increased lumen of the canal being the shedding of its epithelium due to the inflammatory process. Zenker, however, described true hypertrophy of the muscle, and it is true that in the majority of cases a certain, though small, degree of dilatation and hypertrophy actually occurs. On the inflamed surface, plaques of leukoplakia are, in my experience, very frequently seen: they are especially described by Guisez, Bensaude, von Hacker, and Rosenheim.

THE SPREAD OF CANCER OF THE ŒSOPHAGUS

- (1) By direct extension.
- (2) By lymphatic permeation.
- (3) By implantation.
- (4) By physiological propulsion.
- (5) By the blood stream.

1. **Direct Extension.**—The growth, starting in the mucosa, at first spreads more or less concentrically, though, as has been said, it shows a slight preference for the vertical direction, especially in the upper two-thirds of the organ. Infiltration occurs into the submucous and muscular layers of the œsophagus in the neighbourhood of the growth, especially in the scirrhus variety, causing a narrowing of the lumen and local spasm. At a later date a stage of ulceration supervenes, and, at a still later date, spread occurs directly from the principal tumour in the submucous lymphatic plexus. Then follows a stage of invasion of neighbouring organs, together with a local peri-œsophagitis; and ultimately, if the patient lives long enough, all the anatomical structures in the neighbourhood are invaded.

The actual site of the growth, therefore, determines the structures which are directly invaded by it. Thus, at the upper end, the larynx and thyroid are most prone to be affected; in the middle third, the trachea and aorta; whilst, at the lower end, gastric extension frequently takes place. In any portion the vertebral column may be secondarily affected, and involvement of the pleuræ and lungs is frequently found to occur. It occasionally happens that the heart and pericardium are similarly invaded. Adjacent nerves are very frequently affected, becoming embedded in the mass of growth or pressed upon by the glandular metastases. The pathological complications are therefore numerous and of great importance, and are described later at some length. (See p. 169.)

2. **By Lymphatic Permeation.**—There is but a slow tendency for œsophageal

carcinoma to affect the lymphatics or to form metastases, compared with the rapidity with which the growth kills the patient. This usually prevents the lapse of sufficient time for spread by the lymphatic system to be markedly established. When, however, it does occur, the mediastinal and cervical glands become affected. The former may be sufficiently large to cause pressure upon the trachea or a bronchus; those in the neck commonly are situated in the left supraclavicular region (Troisier's or Virchow's glands).

At first the enlarged mediastinal glands do not necessarily contain any carcinomatous cells, but may be purely inflammatory in nature, owing to infective processes taking place on the surface of the carcinomatous ulcer. These glands may suppurate and give rise to mediastinal infection or respiratory or pleural fistulæ. They are usually found embedded in an area of peri-œsophagitis.

Later on, however, carcinomatous infection of the lymphatic glands tends to occur, and an important point when the radical operability of carcinoma of the œsophagus is being considered is the time when the malignant invasion of the glands makes its appearance.

In addition, therefore, to the question whether a carcinomatous growth has invaded



FIG. 91.—Carcinoma of upper end of œsophagus, showing spread to adjacent lymphatic glands and extension along submucous lymphatics. (Author's specimen now in Royal College of Surgeons Museum.)

neighbouring organs, or whether its local peri-œsophagitis has rendered it adherent in the mediastinum, are the questions: Are any local lymphatic glands involved? Are any more remote lymphatic glands involved? Has general metastasia taken place?

In order to answer these questions, in the absence of physical signs of any metastases, the only method is that of recording and analysing a large number of post-mortem findings in patients who have died of the disease. From this, a very fair estimate may be made; but it must be remembered in dealing with the living subject that his condition is not so far advanced as it will be on the day of his death, and therefore the outlook is brighter for the living than it would appear to be from examination of the dead.

Most authors are in agreement that metastases do not tend to occur early, notably Sauerbruch, Guisez, Meyer, Forster, and Billroth. Varying figures give the freedom from metastases as from 46 per cent to 72 per cent of cases.

Helsley, in an analysis of 70 cases carefully examined post mortem with regard to glandular involvement and metastases, found that in 64 per cent the carcinomatous condition was confined to the œsophagus, no secondary deposits being present in the lymphatic glands or other organs. The local lymph-nodes alone were involved in 6 per cent, whilst in the remaining 30 per cent more distant lymph-glands and other viscera were affected.

Blauwkuip records the post-mortem findings in this connexion in 125 cases. Of these, in 39 per cent the disease was localized to the œsophagus, in 47 per cent no glandular involvement by the malignant process had taken place, while 64 per cent showed no metastases in remote organs.

The average duration of symptoms in Helsley's cases was almost five months, and it is therefore obvious that carcinoma of the œsophagus is at first, and for some considerable time, a purely local disease, and that there is ample time for the diagnosis and treatment of a case before metastases occur.

Even if extension to neighbouring organs, or perforation, has taken place, this may be seen when a radical operation is attempted, and, judging from these figures, will be found to have occurred in not more than one case out of two. Even if this type of case has produced glandular metastases at the same rate as all classes of cases taken together, at least 50 per cent of them will not be accompanied by involvement of the lymphatic glands. Helsley goes so far as to state that "irrespective of the duration of the disease, the possibility of metastatic formation without evidence of the same should not be considered as a contra-indication to radical operation".

It would thus appear from pathological findings at post-mortem that at least one case in four is operable to radical methods even up to the time of death. As many cases are seen several weeks or months before death, it would appear probable that at least one in three, or possibly one in two, of all cases seen should be curable by radical surgical operation.

3. **Implantation.**—It is very rare to find that a carcinoma of the anterior wall of the œsophagus has produced by implantation a growth on the posterior wall, but it is not unknown. This may be compared with carcinoma of the

epiglottis, where implantation on the posterior wall of the pharynx occasionally occurs.

4. Physiological Propulsion.—It sometimes happens that small areas of growth are seen dotted about the mucous membrane below a large primary growth, and these are sometimes alleged to be due to portions of the primary growth having become detached and then adherent to the mucous membrane at a lower level. This, however, is highly improbable, as once any material has passed the level of the growth it is very rapidly propelled into the stomach.

If, however, a spasmodic stricture were present at a lower level of the œsophagus, this theory of propagation might occasionally hold good.

But, permeation of cancer of the œsophagus, occurring as it does *via* the lymphatic vessels in a manner similar to that of carcinoma of other organs, there is no doubt that the old theory of physiological propulsion is untenable, and that the so-called secondary growths are really upshoots to the surface of the mucous membrane from the permeated intramural lymphatic vessels. (See Fig. 91, p. 167.)

5. Spread by the Blood-stream.—Direct spread by the extension of the growth along a venous channel has been noted. Leichtenstern reports a case in which a growth extended *via* the azygos vein to the superior vena cava, the right auricle, and the right ventricle.

Definite evidence of embolic spread by the blood-stream has not been forthcoming, as far as I have been able to determine from the literature, nor has any case been seen where it could be demonstrated. Drawing analogy from cases of cancer of the breast, any such spread, if ever present, is of no importance and causes no symptoms, and probably the cells of the cancerous emboli do not live (Sampson Handley).

PATHOLOGICAL COMPLICATIONS

1. Peri-œsophageal Suppuration.—This takes place in the neighbourhood of the primary growth and is due to the passage of organisms from the ulcerated surface of the tumour into the loose cellular tissues around the œsophagus. It occurs by one or more of three methods :

- (i.) By actual perforation of the œsophagus.
- (ii.) By the lymphatic vessels.
- (iii.) By pyogenic infection of lymphatic glands, which subsequently suppurate and break down and infect the cellular tissues.

As a rule, a condition of mild peri-œsophagitis is present in the region of the tumour before actual suppuration occurs, and there tends, therefore, to be some limitation of the track of pus when this is formed. The fascia surrounding the œsophagus, however, is very thin and cellular, and it not uncommonly happens that the suppuration is very diffuse, and pus may be found post mortem dissecting its way amongst all the structures in the mediastinum. It is usually very foetid in character, and may have penetrated into a bronchus, into the pleura, or into the pericardium. Symptoms of a very severe infection are apparent, and, if the patient has not been seen before, it is very difficult,

without an X-ray examination, accurately to ascertain the site of the mediastinal focus. This type of peri-œsophageal suppuration, occurring as it does in enfeebled and elderly patients, rapidly proves fatal.

2. **Hæmorrhage.**—A thick tenacious mucus is regurgitated in almost all cases of cancer of the œsophagus, and, sooner or later, is blood-stained. Actual ulceration into an artery may occur and give rise to a considerable hæmatemesis, and sometimes to melæna, simulating, therefore, the type of

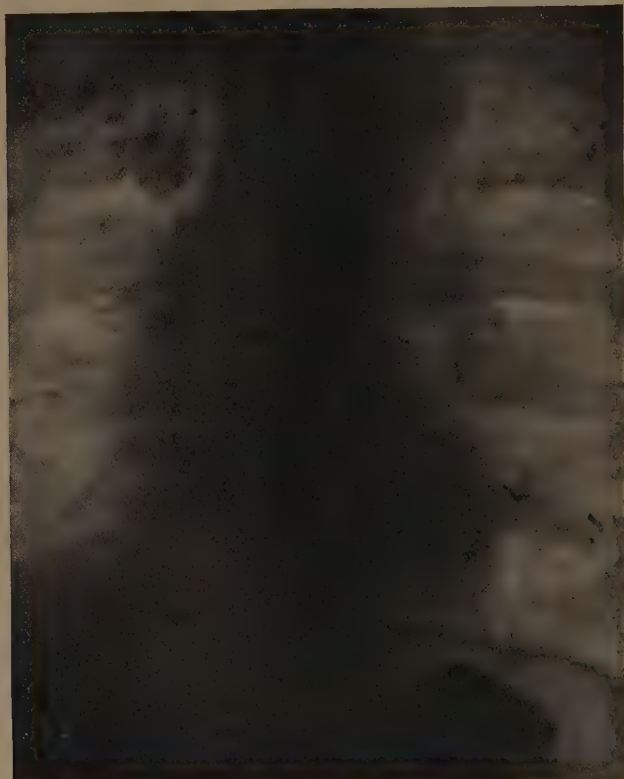


FIG. 92.—Radiogram of case of œsophago-tracheal fistula, showing portions of radio-opaque material scattered through finer bronchioles—antero-posterior view.

hæmorrhage occurring in a simple or malignant ulcer of the stomach. In rare cases, where the growth has invaded one of the great vessels, *e.g.* aorta, pulmonary, carotid, or subclavian artery, an intercostal artery or adjacent vein, very severe and fulminating hæmorrhage occurs, and may simulate the rupture of an aneurysm. Such occurrences are frequently preceded by small premonitory hæmorrhages, and may be precipitated by catheterization.

3. **Complications affecting the Respiratory Apparatus.** (*a*) *Larynx.*—From symptoms alone it is often difficult to distinguish between a growth commencing at the upper end of the œsophagus and directly extending from there

to the larynx, and one which has affected the larynx indirectly by causing pressure upon the recurrent laryngeal nerve or nerves. Difficulty of phonation and laryngeal dyspnœa make their appearance, and laryngoscopic examination must be made in order to ascertain the true nature of the laryngeal involvement.

(b) *Trachea and Bronchi*.—The close apposition of these structures to the œsophagus explains the frequency with which they are secondarily involved in cases of cancer of the upper and middle thirds of this organ. They may be affected, and especially the left bronchus, either by the growth itself or by the pressure of enlarged lymphatic glands. Dyspnœa makes its appearance and may be constant or paroxysmal in nature.

If a cancerous infiltration occurs, actual ulceration, with the formation of a tracheo-œsophageal or broncho-œsophageal fistula, is produced. This gives rise to great difficulty in swallowing fluids, which immediately pass into the bronchus and precipitate a severe attack of coughing, resulting in the ejection of the fluid. In a case referred to by Souttar, also in one described by Mathieu and Moutier, these symptoms disappeared for a time on account of the mass of growth blocking up the fistula and also the bronchus; the patient died shortly afterwards from gangrene of the lung. It is sometimes possible, if the fistula

is large enough, to detect the exit of air through a catheter passed into the œsophagus. The patient is always in danger of asphyxia, especially on swallowing, and pneumonia and pulmonary gangrene are likely to make their appearance at any time. These cases, therefore, demand immediate gastrostomy.

X-ray examination with a bismuth emulsion will demonstrate such a perforation, and show the bismuth penetrating the bronchus and taking the form of an opaque arborization corresponding to the bronchial tree. The

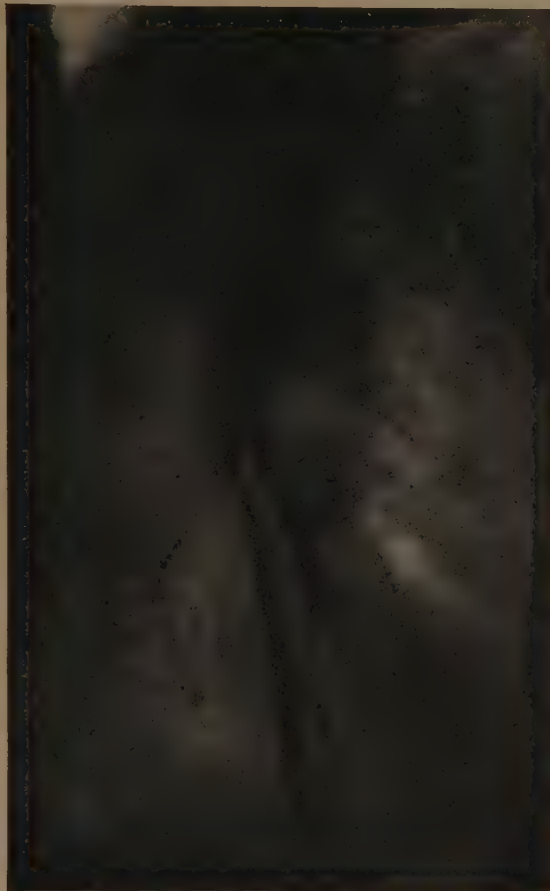


FIG. 93.—Radiogram of case of œsophago-tracheal fistula, showing outline of bronchial tree by bismuth which had been swallowed—oblique view.

patient is less distressed than might be expected, and rapidly coughs up the opaque material. It is important in this type of case to use a solution of bismuth subnitrate, and not of barium.

(c) *Lungs and Pleuræ*.—These are affected in four ways :

1. By infection, especially causing broncho-pneumonia, lobar pneumonia, pulmonary gangrene, and empyema.

2. By involvement of the vagi, causing paralysis of the unstripped muscle of the bronchi and bronchioles.

3. By involvement of one, or, rarely, both phrenic nerves, thereby causing a certain degree of massive collapse of the base of the lung, together with congestion and local œdema, which is rapidly followed by superimposed infection.

It is particularly common at the post-mortem examination to find patches of pulmonary gangrene : this has usually revealed itself clinically by repeated attacks of hæmoptysis, together with which the patient regurgitates foetid reddish or greyish pus, which may be associated with clinical signs of bronchiectasis.

The pleural cavity may contain a sero-fibrinous or purulent effusion without any actual perforation of the pleura. If a fistula has occurred from the lumen of

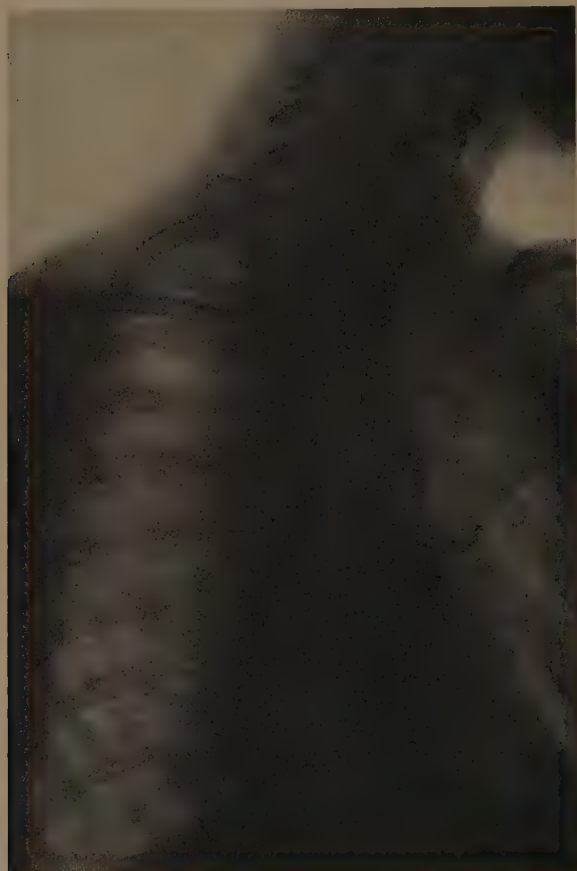


FIG. 94.—Radiogram of case of œsophago-tracheal fistula, showing bismuth in pharynx, œsophagus, trachea, and bronchi—antero-posterior view.

the œsophagus a pyopneumothorax is present. Depending on the amount of adhesions or their absence is the localized or generalized condition of such a pleural effusion. Galliard has noted multilocular pleural effusions.

Septicæmia or pyæmia occasionally supervenes upon pleural infection.

4. *Mediastinal Nerve Complications*.—At the upper end the recurrent laryngeal nerve may be affected on either side, very rarely on both sides simultaneously. This produces the laryngeal symptoms due first to irritation

of one laryngeal nerve, then complete paralysis of the vocal cord on that side, occasionally closely followed by irritation and paralysis on the opposite side. The effect of irritation of one nerve—the left is more commonly the first to be affected—is to cause an abductor paralysis of the left true vocal cord, which therefore appears in a position of adductor spasm, and is seen on laryngoscopy to be immobile, with its inner border in the mid-line. When complete paralysis occurs, the affected cord is seen to be in a position midway between abduction and adduction, and to have no active movement. The passage of air over it, however, may cause a little passive movement. It rarely, though occasionally, happens that both recurrent laryngeal nerves are affected simultaneously: in this case the cause is more commonly bilateral involvement of the cervical glands than direct involvement by the primary growth. When this happens both vocal cords are subjected to abductor paralysis. They are thus thrown into a state of bilateral adductor spasm, a condition incompatible with life, and, unless laryngotomy or tracheotomy is immediately performed, death ensues. This condition is similar to that occurring in a tabetic laryngeal crisis.

The ultimate result of complete, but not simultaneous, involvement of both recurrent laryngeal nerves is that both vocal cords are completely paralysed, are found to be in the cadaveric position, and move only with the movements of inspired and expired air.

The nerve next most commonly affected in the region of the upper part of the œsophagus is the sympathetic nerve-trunk on either or both sides. At first, irritation of this produces a dilatation of the pupil of the corresponding side with a slight degree of exophthalmos. Later, when paralysis supervenes, the pupil is found to be contracted and fixed, and enophthalmos is present.

One or both vagi nerves may be affected. Of this there may be no symptoms whatever, but occasionally cardiac arrhythmia is present, with dyspnœa, coughing, and vomiting.

Rarely the phrenic nerve has been affected, giving rise to hiccough, or even paralysis of the diaphragm.

The effects of pressure on the intercostal nerves may manifest themselves by neuralgic pains in the thorax.

5. Involvement of the Thyroid Gland.—Carcinoma arising at the upper end of the œsophagus may spread to the adjacent thyroid gland, and a patient may present himself with what appears to be primary malignant disease of this structure. Similarly, the converse holds true. Any such case, therefore, must be examined carefully in order to be sure that the real primary site of the disease is not overlooked.

CHAPTER XV

CANCER OF THE ŒSOPHAGUS—(*continued*)

DIAGNOSIS

(1) SYMPTOMATOLOGY.—In every case of cancer, the earlier a diagnosis is made the greater is the likelihood of cure by modern methods, that is, by radical surgical removal of the growth. Similarly, the earlier the use of palliative measures, radium, or X-rays, the greater is their success, and the more nearly do they approach to a cure.

The present lack of success in the treatment of cancer of the œsophagus is due to a large extent to the late stage at which the condition is originally diagnosed; practitioners as a whole appear to have very great difficulty in arriving at the diagnosis until a comparatively late stage of the disease has been reached. In addition to this is the general feeling amongst the profession that even if the diagnosis is established there is little or nothing that can be done for the patient, and it is therefore very rare for a surgeon to see a patient before most definite symptoms have been present for a considerable time. Consequently, it is almost unknown for a surgeon to see a case before continuous dysphagia is present. As a rule, the patient has been suffering from definite and increasing difficulty in swallowing for from four to twelve months before expert examination or advice is sought.

The first step, therefore, towards cure of the condition must be a recognition of its earliest symptoms, followed immediately by the most careful œsophagoscopic examination of the patient. I shall therefore describe, firstly, the early or so-called premonitory symptoms which are present in cases having an insidious onset, and secondly, the symptoms which arise at a later stage, when the condition is well established.

A. Earliest Symptoms.—Dysphagia is not by any means invariably the earliest symptom of cancer of the œsophagus. Before actual difficulty in swallowing arises, the patient may experience a curious abnormal sensation in the thorax, which may or may not be related to swallowing. A sense of oppression or weight or fullness is felt behind the sternum. It is important to emphasize that actual pain is conspicuous by its absence, and the sense of discomfort is due to the slight dilatation of the œsophagus from the early narrowing of its lumen, together with colicky sensations of oppression due to

increased muscular contractions of the organ. These sensations are usually noticed when swallowing is attempted, but may be present independently of deglutition. Then the patient may find that in order to overcome the sense of fullness while eating he has to take considerable draughts of fluid with his meals in order to wash the food into the stomach.

Other patients may notice occasional choking sensations while taking a meal, or even temporary and transient attacks of actual difficulty in swallowing. Occasionally the patient notices nothing other than a slight excess of saliva or mucus in the mouth and throat. In other cases the patient may complain of loss of appetite, or indigestion, or a sense of discomfort in the epigastrium, and may receive treatment for supposed gastritis or gastric ulcer for many months before a lesion of the œsophagus is discovered. At length in almost all cases there is a distinct obstruction to the passage of food.

Richard Cabot, as a result of three thousand post-mortem examinations, arrived at the conclusion that a greater proportion of mistakes in diagnosis had been made in cases of cancer of the œsophagus than in any other condition, and the expression of a similar opinion was recently made to me by the medical superintendent of a large London infirmary. Cabot also states that in four cases out of twenty dysphagia was not present up to the time of death.

B. Later Symptoms. (i.) *Dysphagia*.—This is the most constant symptom, and, although usually preceded for several weeks or months by premonitory symptoms as described above, it is in cases with a sudden onset the first symptom to appear. It makes its appearance at different stages in the course of the disease, and is due to two factors: (a) spasm of the wall of the tube occasioned by the presence of the growth; (b) the presence of a tumour obstructing the lumen of the organ.

The dysphagia is essentially progressive, at first being noticed with solids, later with semi-solids, and lastly with liquids.

Variations are occasionally seen, and it sometimes happens that the dysphagia is of sudden onset, and the patient is able to date the commencement of symptoms from a particular meal, when, perhaps, particularly large particles had been swallowed and the sudden sense of discomfort made its appearance. At the same time, the patient may notice that the food appears to stop at a certain level, but, although this is a characteristic symptom, the level indicated by the patient may bear no relation to the level of the lesion in the œsophagus.

The second anomalous variety is that in which a patient with a slowly progressing dysphagia suddenly experiences a severe difficulty in swallowing. This is due to an acute spasm of the œsophagus, either at the site of the lesion, or occurring reflexly at the upper opening.

A third type which varies from the more usual may occur in patients who have the proliferative or polypoid variety of growth, and in whom a large fragment of the tumour has become detached, thus allowing a temporary improvement of the dysphagia.

Lastly, patients who have suffered for many years from cardiospasm which has not become gradually worse may suddenly show symptoms of a considerable

and progressive increase in the stenosis. One must not be led astray in these cases by the long history, but must take pains to discover the cause of the sudden exacerbation, which is frequently found to be the onset of malignant changes.

(ii.) *Pain*.—In the early stages of carcinoma of the œsophagus, and frequently throughout almost the whole course of the disease, pain is conspicuously absent. The patient may, however, experience a sense of discomfort and “fullness”, usually referred to either the upper or the lower end of the sternum. Later, if a considerable ulcerated surface is present, he may experience a burning sensation when food touches this. It is not until the growth has affected neighbouring structures, especially nerves, that really painful sensations are experienced; then, the radiation of the pain corresponds to the various nerves which are affected, and occurs chiefly at the back of the neck or between the shoulder-blades.

(iii.) *Vomiting*.—The vomiting which occurs after the premonitory symptoms have been present for a shorter or longer period of time is not, of course, true gastric vomiting: it is really a regurgitation of unaltered or almost unaltered food, and is frequently called “(Esophageal Pseudo-vomiting”. The patient tends to return small quantities of food from time to time after taking a meal; it is mixed with a certain amount of mucus, saliva, and possibly blood, and on chemical examination no hydrochloric acid can be demonstrated in it. If a previous dilatation has existed, or if the œsophagus has become dilated with a slow-growing annular stricture at the cardia, the capacity of the œsophagus may be much increased and the pseudo-vomiting may be delayed for several hours, and tends to simulate true vomiting more closely; the regurgitated material may be very foetid, and may show the presence of organic, and even a little hydrochloric, acid in it.

This regurgitation of food must not be confounded with the regurgitation of mucus and saliva. It is well known that, in all cases of œsophageal obstruction, the patient experiences a great increase in the flow of saliva. This abundant sialorrhœa occurs most markedly in cancerous patients, and if present adds considerably to their sufferings. The hypertrophy of the salivary glands may be great enough to simulate mumps. Mathieu states that the condition may persist after gastrostomy, but most observers note its disappearance after gastrostomy or intubation. Roger assumed that an œsophago-salivary reflex was present, but the facts just referred to render this highly improbable.

C. General or Constitutional Symptoms.—The chief of these is the extreme wasting which the patients undergo, losing, as they do, many pounds in weight in the course of a few months: this is due partly to lack of nourishment and partly to lack of water. The latter leads to the most severe thirst, and also to constipation; the urine is scanty; and the subcutaneous tissues are thinned, causing the eyes to sink and the skin to become lax. Extreme wasting occurs in all forms of relatively acute stenosis of the œsophagus, but even when the cause is a cancer the typical cachectic appearance of a carcinomatous patient rarely has time to develop, on account of the rapidity with which a fatal

termination is brought about by starvation unless adequate treatment is given.

(2) **PHYSICAL SIGNS.**—The patient, usually a middle-aged man, complains of the symptoms indicated above, namely, a sense of discomfort in the thorax, or a sense of fullness after meals, or loss of appetite, or difficulty in swallowing of shorter or longer duration, possibly with occasional regurgitation of food, and rapid wasting.

On inspection, it rarely happens that anything can be seen of the local condition, although occasionally a slight fullness can be detected above the manubrium sterni, or, if a dilatation of the œsophagus is sufficiently pronounced above the malignant stricture, it may be seen and give the appearance of a pouch. The more common abnormality seen on inspection of the neck is the fullness in one or other, rarely both, of the posterior triangles of the neck, due either to a dilated œsophagus, or the presence of a tumour, or enlarged lymphatic glands. The best method of observing this is to inspect the neck when the patient is lying supine, the examiner standing at the head of the couch. If an even light illuminates both sides of the neck, an abnormality of one side may sometimes be seen better than it can be felt.

On palpation, it is occasionally possible to detect a tumour below the level of the cricoid cartilage, or a pouch, if present, may sometimes be felt. In the left posterior triangle an enlarged gland, or glands, may be palpated, and this may be the only physical sign which can be detected. In such a case a most careful systematic examination must be made of the whole body. These glands, known as Virchow's or Troisier's glands, are at first firm, but discrete, not matted together, and are not of the characteristic hardness which definitely points to malignant disease. The first stage, therefore, in arriving at an opinion with regard to their nature is to make sure that no other glands in the body are enlarged, that the spleen is not palpable, and that tuberculosis and syphilis are not responsible. In the differential diagnosis of tuberculosis, difficulty is apt to be encountered because concomitant enlargement of the tracheo-bronchial glands may give evidence of abnormalities in the lungs. This accounts for statements by earlier workers that pulmonary tuberculosis is common in conjunction with carcinoma of the œsophagus, whereas in point of fact the association is rare.

Secondly, all areas of which the lymphatics drain into the left posterior triangle of the neck must be examined for a primary infective focus. These, of course, include the whole body except the right side of the neck and thorax, and the right upper extremity. The possible presence of a primary malignant focus elsewhere than in the œsophagus must be considered and sought for in a similar manner. I have seen a case in which the only complaint was a mass of glands in the left supraclavicular region with slight difficulty in swallowing, and many differing diagnoses were suggested. On a systematic examination being made the patient was found to have a new growth of the testis, with sarcomatous glands in the mediastinum and supraclavicular region. He had not noticed the enlargement of the testicle.

Later, when the character of the glands is apparently of definitely malignant nature, the chief point in differential diagnosis arises in connexion with gummatous glands: these are frequently found to be of a harder consistency than malignant glands, and it is important not to be led astray in this respect; frequently a microscopical examination is needed in order to establish a

correct diagnosis.

If no physical sign other than an enlarged gland in the supraclavicular region is found, this should be removed for microscopical examination. It has been known to lead to an early diagnosis of carcinoma of the œsophagus before symptoms were present to focus attention on this organ (Bensaude and Rivet). It should be noted, however, that such a finding is extremely rare, as the facts relating to metastases, given above, indicate (p. 168).

Percussion rarely proves to be of any assistance, though occasionally the retro-dilatation of the œsophagus is sufficient to cause an impairment of note behind the manubrium sterni; this, of course, is very suggestive of aneurysm, the existence of which should have been previously suspected by physical signs obtained on



FIG. 95.—Radiogram of a case of carcinoma of the middle third of the œsophagus. (Note poor definition usually obtained in antero-posterior plane.)

inspection and palpation of the neck, especially the trachea (tracheal tug), the suprasternal notch, the anterior aspect of the sternum (visible pulsation), and inequality of the two radial pulses. Percussion should be employed as a routine, together with inspection and palpation of the thorax generally, as it is important that all the contents of the chest be subjected to a careful clinical examination in order that signs of extrinsic pressure upon the œsophagus are not overlooked.

Auscultation is first practised in a general manner over the chest, careful note being made of cardiac sounds, with a view to excluding the presence of aneurysm, and secondly, with a view to excluding or establishing the

presence of signs of pressure upon the bronchi or involvement of the lungs. With regard to auscultation of the œsophagus itself, only slight and uncertain information may be obtained by listening with the stethoscope placed beside the dorsal vertebral spines while the patient swallows a mouthful of water, which may readily be heard to pass down the canal. Before each act of deglutition the chest-piece of the stethoscope is moved some two inches further down the back, and occasionally a fairly accurate localization of the site of the obstruction can be ascertained. When listening at the level of the tenth dorsal vertebra six seconds must be allowed after the patient has swallowed before the squirting sound is normally heard as the fluid is propelled into the stomach. This method, while of interest and of some slight value in the out-patient department as a rough indication of the level of the obstruction, is by no means accurate. An alternative measure is to make the patient swallow a glycerine pastille to which a thread has been attached. An approximate indication of the site of the obstruction is obtained, and no danger accompanies this procedure.

These methods are not to be relied upon with the accurate diagnostic measures now at our disposal.



FIG. 96.—Radiogram of a case similar to that shown in Fig. 95.

Note.—This radiogram shows better definition than Fig. 95, but in my experience it is rare that such good definition is obtained with a radiogram when taken in the antero-posterior position. Early narrowing of the lumen of the œsophagus in its upper third is especially difficult to determine on account of the density of the bony structures in this region; namely, the manubrium sterni and vertebræ in the antero-posterior plane, while in the lateral and oblique positions the clavicles, scapulæ, and humeri tend to make accurate observation difficult. Special attention must therefore always be paid to this region of the œsophagus on radioscopy.

(3) LARYNGOSCOPY.—Laryngoscopy is practised, first, in order to exclude any lesion of the pharynx or larynx ; secondly, to inspect the upper extremity of the œsophagus, as it may show the presence of a primary growth in the so-called post-cricoid region of the œsophagus ; thirdly, in order to ascertain accurately

the exact nature of any associated lesion, *e.g.* paresis or paralysis of a recurrent laryngeal nerve.

(4) RADIOSCOPY. — Together with œsophagoscopy, radioscopy is the most valuable method of examination of the œsophagus. It should be carried out at first by the use of the fluorescent screen, and there is no doubt that the most satisfactory position is obliquely through the thorax. The fluorescent screen should be held on the left side of the patient's chest ; all blurring due to the sternum and vertebral column is thereby avoided, and a radio-opaque material in the œsophagus is clearly seen with only relatively non-opaque lung tissue on either side of it.

Before any radio-opaque substance is swallowed the first point to note is the presence or absence of an abnormality in the thorax or neck. The presence of aneurysm, intrathoracic goitre, and primary or secondary new growth of the lung and mediastinum having been excluded, a mouthful of bismuth or barium emulsion, prepared as described on p. 23, is swallowed by the patient.

On fluoroscopy, the following facts must be ascertained with reference to the œsophagus :

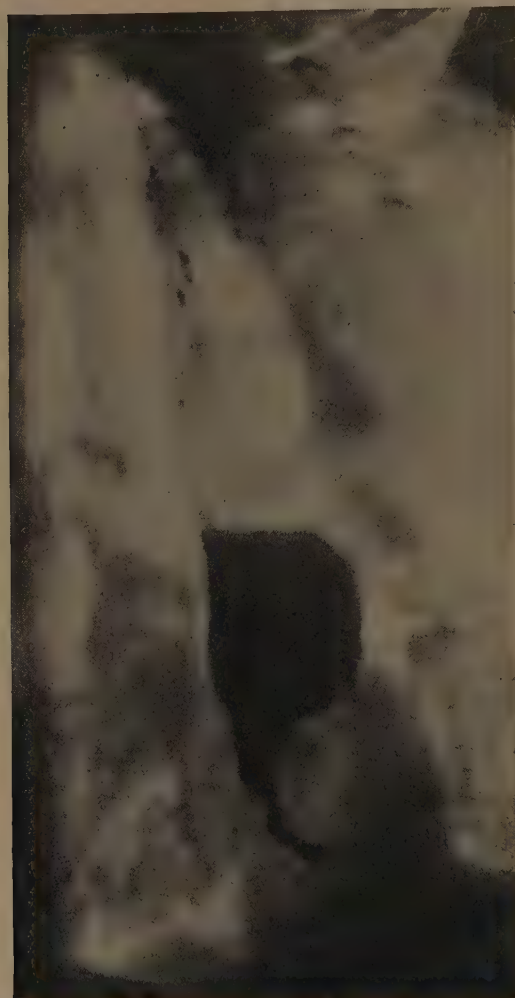


FIG. 97.—Radiogram of a case of carcinoma of the lower third of the œsophagus. (Oblique view showing rat-tail-like appearance.)

- (1) The size of the lumen.
- (2) The relative position which the organ occupies in the chest cavity.
- (3) The presence of any obstruction.
- (4) The site of the obstruction.
- (5) The degree of the obstruction.

- (6) The degree of dilatation of the œsophagus, as shown by the opaque material when a sufficient quantity has been swallowed to distend such dilatation or pouch.

These facts, together with the peristaltic movements of the œsophagus, can be studied better by radioscopy than by radiography, and the patient may be turned so that the most advantageous position is obtained. As soon as this is done and the required observations are made, a previously prepared plate is adjusted into position and a precise and permanent radiogram taken.

With the use of the opaque material the picture obtained varies with the degree of stenosis present.

(a) Even when no stenosis is present, X-ray examination is of value, as it may show retention of a small portion of the opaque substance at the site of an early lesion, similar to the shadow sometimes seen at the site of a gastric ulcer after the main gastric meal has passed on. This is most typically observed in a carcinomatous ulcer developing in a previously dilated œsophagus.

(b) If only a slight stenosis is present, no arrest of the fluid is seen, but a slight diminution in the calibre of the œsophagus may be indicated. This sometimes calls for a repetition of the examination, or at least indicates the region to which special attention is to be paid on œsophagoscopy.

(c) With a more pronounced but incomplete stenosis, the opaque material is noticed to be arrested temporarily, and is then seen to pass slowly in a fine streak down the lumen. Below the level of arrest the œsophagus is never well filled, as the substance passes rapidly into the stomach. It is therefore very difficult, by means of ordinary radioscopy or a radiogram taken in the upright

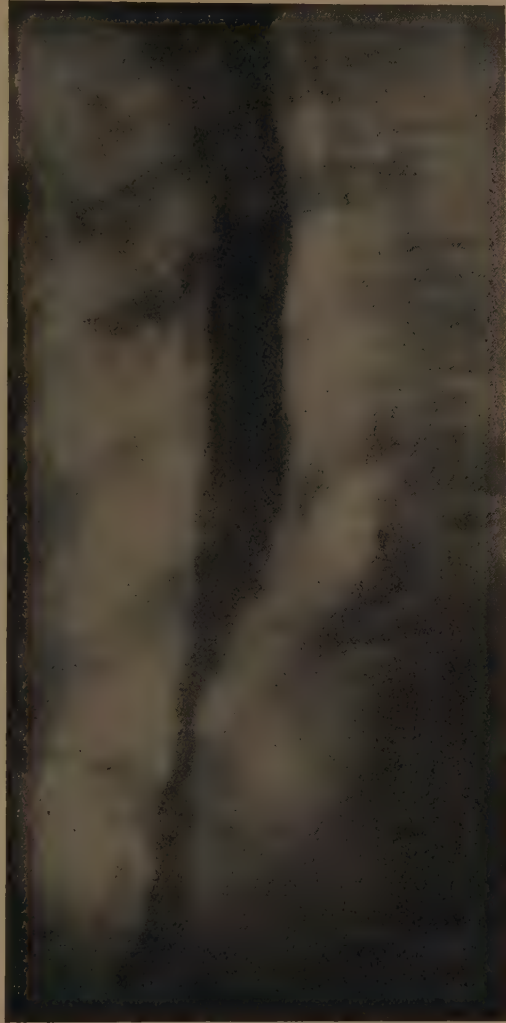


FIG. 98.—Radiogram of a case of diffuse carcinoma of the lower half of the œsophagus.

position, accurately to ascertain the lower limit of the stenosed area of the œsophagus. As this knowledge is frequently important, a radiogram must be taken with the patient in the Trendelenburg position, when he is swallowing the radio-opaque drink. In these circumstances the fluid is propelled along

the œsophagus as if it were a solid bolus, and the lower limit of the strictured area is clearly defined. If the patient has had a gastrostomy, the radio-opaque material may be poured into the stomach; then, again utilizing the Trendelenburg position, two or three successive acts of swallowing will cause an opening of the cardiac sphincter, and the portion of the œsophagus below the stricture will be filled from the stomach, and the required information obtained.

These methods are described in detail under General Methods of Diagnosis (p. 24).

(d) With a very tight stenosis, the opaque matter is seen suddenly to stop, and further mouthfuls accumulate above this level. The œsophagus may be seen to be somewhat dilated, though dilatation is rarely marked except in growths situated at the cardia, as explained in the section on Pathology (p. 166).

The lower border of the opacity is typically irregular in outline and is sometimes referred to as being "nipple-shaped" or "rat-tail-like". Frequently the

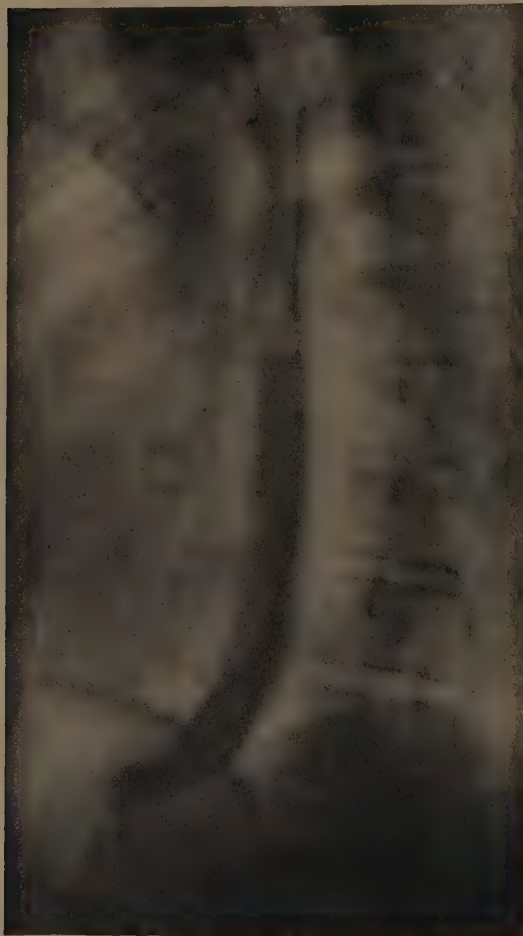


FIG. 99.—Radiogram of a case of carcinoma of the lower end of the œsophagus.

opaque column exhibits movements caused by peristalsis and anti-peristalsis.

Even if the exact nature of the cause of the obstruction is not typical enough to allow of a certain diagnosis, the site of the stenosis is located, and endoscopic examination is rendered easier.

(5) ŒSOPHAGOSCOPY.—This method of examination is of considerable importance, especially in the earlier stages of the disease, and should always be undertaken in order that an accurate diagnosis may be made. Œsophagoscopy

must always be performed with the utmost care and gentleness, but the examiner's efforts to avoid any trauma to the gullet should be redoubled in a case of suspected new growth. As a rule, the diagnosis is easy when a growth is seen, but a portion of the abnormal tissue may be removed for microscopical examination. Needless to say, this must be done with the greatest care.

Appearances on Œsophagoscopy.—For details of technique and instrumentarium see *Œsophagoscopic Technique* (pp. 30 *et seq.*).

As the examining tube approaches the level of the lesion the wall of the Œsophagus appears relatively immobile and stiffened, and does not move, as it has been noticed to do at a higher level. The mucosa becomes redder in colour, owing to increased vascularity. The surgeon at the same time notices a peculiar fœtor.

The actual appearance of the growth varies with the type that is present. In the first, or proliferative, variety it has the cauliflower-like appearance described above (p. 164). The tumour is seen to be covered with a blood-stained, fœtid discharge, and bleeds very easily (Plate II. v, facing p. 152).

In the second, or ulcerative, type, the hard, raised, irregular, and everted edge is first seen; the ulcer appears somewhat raised, and the surrounding wall



FIG. 100.—Radiogram of a case of carcinoma of the stomach with involvement of the lower end of the Œsophagus.

Note the marked dilatation of the Œsophagus, with clear cut lower extremity. The lumen (in the full-sized plate) is seen to narrow a quarter of an inch above the cupola of the diaphragm. It is, therefore, maintained that there is a true spasm of the cardiac sphincter. (The latter, as has been shown, extends for some distance above the Œsophageal opening in the diaphragm.) This case illustrates one of the causes of cardiospasm, namely, a gastric lesion. An X-ray examination of the stomach, taken in Trendelenburg's position after swallowing an opaque meal, showed a filling defect at the fundus, involving the anatomical cardia and lowest inch of the Œsophagus. When gastrostomy was performed a very extensive growth was found; the post-mortem specimen of this case is shown in Fig. 101.

dense and indurated. A light touch with a swab removes blood-stained foetid material (Plate II. x, facing p. 152).

In the third, or scirrhus, type, the lumen of the œsophagus is seen to be greatly narrowed and deformed, whilst the mucosa appears retracted, red, smooth, and immobile (Plate II. t and w).

Above the stenosis, plaques of leukoplakia are frequently found; dilatation is rarely obvious except in patients who also have long-standing cardiospasm.

Early carcinoma of the œsophagus is not often seen; the presence of a slightly projecting immobile mucosa with no obstruction to the passage of the tube is easily overlooked, and must be searched for most carefully. As the œsophagoscope is withdrawn the observer should specially notice the manner in which the canal appears to close, as local rigidity and non-closure are characteristic of an early malignant lesion.

Occasionally a marked spasm is present at the upper end of the œsophagus, making it quite impossible to pass an œsophagoscope on the first attempt. Such spasm may be overcome by a few days' preliminary treatment with bromides and belladonna, together with the exhibition of a local anæsthetic. Occasionally it may be so severe that a general anæsthetic is required.

Retrograde Œsophagoscopy.—If it is thought advisable to determine by direct vision the level of the lower border of a growth in the œsophagus, this may be accomplished by means of an œsophagoscope passed through the stomach after a gastrostomy has been performed. This has already been described as retrograde œsophagoscopy (p. 43). By this means the lower limit of a growth is seen and determined, and, a previous examination having localized the upper limit of the tumour, the complete extent of the growth in a vertical direction is now known.

Tracheo-bronchoscopy and Gastroscopy.—If the growth which has been diagnosed in the œsophagus is high enough to make extension to the trachea or bronchi possible, œsophagoscopy should always be supplemented by tracheo-bronchoscopy before any attempt at radical removal is undertaken, in order to be sure that the air-passages are not invaded by the growth.

Similarly, with a growth at the lower end of the œsophagus gastroscopy should be performed. I have recently had in hospital at the same time three patients, in each of whom an early growth was diagnosed at the lower end of the gullet. An ordinary opaque meal failed to show any abnormality of the stomach; but laparotomy with a view to attempting a radical cure revealed an extensive growth of the fundus which could have been diagnosed correctly had gastroscopy been performed.

In similar cases it is important to decide whether the growth is arising primarily in the œsophagus, or secondarily to a gastric carcinoma; gastroscopy should be performed, and the interior of the stomach examined. (See p. 42.)

DIFFERENTIAL DIAGNOSIS.—One case in every two with symptoms of a lesion of the œsophagus is cancerous in nature, and no case with symptoms pointing to an œsophageal disease should be allowed to pass without a very careful routine examination. Every patient with symptoms of fullness in the thorax,

especially if related to swallowing, or a sense of obstruction, or the regurgitation of food, or actual difficulty in swallowing, is to be suspected of having cancer of



FIG. 101.—Drawing of post-mortem specimen of same case as Fig. 100.
(Author's specimen now in Royal College of Surgeons Museum.)

the œsophagus until the contrary has been definitely proved. Every effort

must be made to establish an accurate diagnosis, other causes of œsophageal obstruction being systematically excluded.

The first question to be asked is : Is the condition due to an extra-œsophageal lesion ? and secondly : If the disease is œsophageal, what is the nature of the lesion ?

A. **Extrinsic compression** of the œsophagus may best be classified as it occurs—

- (i.) In the neck.
- (ii.) In the mediastinum.
- (iii.) In the abdomen.

(i.) The causes in the cervical region arise mainly from the thyroid gland in the nature of simple or malignant goitres ; these are easy to recognize, except when an intrathoracic goitre is present. More rarely, enlarged lymphatic glands, or tumours arising in connexion with nerves or of vestigial origin, occur, and their presence is easily perceptible.

(ii.) In the mediastinum, the commonest tumour which has to be excluded is an aneurysm of the thoracic aorta. The routine examination of every case, with special and careful search for signs and symptoms of this lesion, together with X-ray examination, as previously described, should lead to its detection. If, however, œsophagoscopy is performed in the absence of an X-ray examination, the wall of the œsophagus in the region of the aneurysm gives the appearance of being pressed inwards from without and shows a pulsating convexity. On this being observed, the operator should immediately withdraw the tube, as an aneurysm is readily ruptured. It is not always easy to be certain on œsophagoscopy that an aneurysm is present, as a tumour of the œsophagus itself may show transmitted pulsation from a normal aorta.

Other mediastinal tumours should also have been excluded by X-ray examination before further investigation of a case. These have already been described (p. 93), *e.g.* :

(a) Glandular enlargements, which may be tuberculous, malignant, lymphadenomatous, or lympho-sarcomatous in nature.

(b) Inflammatory lesions ; chronic mediastinitis or peri-œsophageal abscess.

(iii.) In the abdomen (see p. 94), *e.g.* subphrenic abscess, gastric carcinoma, etc.

B. **Œsophageal Affections simulating Carcinoma.**—As already pointed out, the length of history of the case has usually been sufficient to exclude fibrous strictures resulting from the swallowing of a corrosive or a foreign body, but it is important to remember that a malignant growth may develop upon an inflammatory or spasmodic stricture and thus give rise to great difficulty in diagnosis.

The site of the obstruction having been ascertained by radioscopy after an opaque substance has been swallowed, the actual cause of the obstruction is determined by the œsophagoscope. All these causes are discussed at length elsewhere, and are simply enumerated here.

1. **Spasm**, which is at first transitory, may demand more than one œsophagoscopic examination and may need antispasmodic treatment before the examination can be satisfactorily concluded. Especially in cardiospasm,

œsophageal dilatation occurs and may give rise to symptoms of œsophagismus, which the French call the "pseudo-cancerous" type. As this name is apt to be misleading and does not appear to be of any practical utility, it need not be mentioned again.

2. **Œsophagectasia** or **mega-œsophagus** may be accompanied by superimposed malignant growth, which then pursues a particularly "silent" course. (Letulle and Jacquelin ; Cade and Morenas ; Bensaude and Guénaux.)

3. **Diverticula** : the possibility of cancer developing in connexion with a diverticulum must not be overlooked.

4. **Benign Tumours**.—The so-called polypi are rare, and always demand removal of the whole, or of a portion, for microscopical examination.

5. **Inflammatory Lesions.**

(a) Simple ulcers.

(b) Specific ulcers : typhoidal and diphtheritic.

(c) Granulomata : syphilis and tuberculosis.

All these are rare, in the early stages occurring as a simple ulceration and only after a considerable time causing actual stenosis.

6. **Gastric lesions** may produce an œsophageal syndrome closely simulating primary œsophageal lesions, and gastroscopy is frequently indicated in addition to œsophagoscopy.

CHAPTER XVI

CANCER OF THE ŒSOPHAGUS—(*continued*)

TREATMENT

A. PROPHYLACTIC TREATMENT.—Prophylactic treatment has very little scope, and all that need be said is that a long-standing stenosis or a dilatation with œsophagitis should be carefully treated and kept under observation for many years, in order that the inflammatory processes may be either cured or reduced to a minimum, thus considerably reducing the tendency for malignant disease to develop.

B. IN DEVELOPED CASES.

1. **Medical Treatment.**—The diet of a patient suffering from cancer of the œsophagus demands careful attention, and it is of the utmost importance to ensure that it is as nutritious as possible, and of a soft, fragmented nature. Feeding by the mouth should be continued as long as possible, but gastrostomy should not be delayed after the patient begins to have difficulty in swallowing *soft solids*. No irritating foods should be allowed; Mathieu advocates glutinous foods, for example, tapioca, soups, minced meat, and fish, together with milk and milk foods, eggs, and a large amount of butter and cream and mashed potato, which help to combat the rapid wasting. The meals should be small and frequent, and large quantities of fluid should be taken.

If the case is seen early in the disease, when no difficulty is experienced with soft solids, deglutition may be restored almost to the normal if treatment is undertaken immediately. If, however, difficulty in swallowing soft solids has already made its appearance and oral feeding is persisted in as the sole means of nutrition, the patient becomes rapidly worse and had better be fed through a gastrostomy. Rectal feeding has been advocated by some authors in order to allow complete rest to the œsophagus, with the view of diminishing inflammation and spasm. It is rarely that this method need be considered, as very little nutriment can be absorbed by the bowel except when given in the form of glucose; a dehydrated patient can absorb large quantities of fluid, which is best given in the form of normal saline by a continuous drip method, with a rectal tube passed at least twelve inches into the bowel. The amount of glucose added to this should not be more than 20 per cent, and even this may be found to be too large and to cause non-retention.

2. **Symptomatic Treatment.**—Very little benefit is gained from medicines in these cases. As a general tonic, I find that a mixture of gentian and soda helps many patients, and the addition of iron and arsenic is sometimes beneficial. Strychnine should be avoided, as it produces painful œsophageal spasm. A course of bromides with belladonna and hyoscyamus has a definite antispasmodic effect, and the exhibition of these drugs does much to improve the patient's swallowing. For those cases which experience a spasm at the time of a meal, one or two drachms of a 0.25 per cent cocaine solution given some ten minutes before the meal, will often relieve this symptom. Papaverine has a similar action. If pain is present, or makes its appearance during the course of the disease, recourse should be had to small doses of aspirin, five to ten grains three times a day, or at the time when the pain comes on. Small doses of phenacetin and phenazone may also be used, or a mixture of a small quantity of two or all three of these coal-tar derivatives.

When these begin to lose their effect, recourse may be had to heroin. This drug is less depressing than morphine and does not produce gastro-intestinal disturbances. It may be given in the form of a pastille containing one-fortieth to one-twenty-fourth of a grain, from three to eight times a day without any bad effect upon the general health. Still later it may have to be given by subcutaneous injection, using one-twelfth to one-sixth of a grain twice a day or oftener. If belladonna is not being given by the mouth, atropine should be combined with the injection of heroin in order to diminish salivation.

In the last stages of the disease morphine may have to be used, either alone or combined with either hyoscine or cocaine. A mixture of morphine and cocaine, when the patient has considerable pain, appears to be a very efficacious combination when given by hypodermic injection, and is used in the dosage of

morphine gr. $\frac{1}{8}$ – $\frac{1}{4}$

cocaine gr. $\frac{1}{8}$ – $\frac{1}{4}$

once, twice, or even three times in twenty-four hours.

3. **Local Treatment.**—Every case of carcinoma of the alimentary canal is accompanied by secondary inflammation due to infective or septic micro-organisms. This secondary infection is most virulent in the mouth, pharynx, and œsophagus, and is most marked in patients who have teeth. It is therefore most essential to deal with any focus of infection in the mouth, and, for that matter, in the nasal sinuses also. I have seen many striking examples of this; for example, a case of carcinoma of the hypopharynx was diagnosed on microscopy. Clinically the condition appeared inoperable. Shortly after the patient had been rendered edentulous the growth could not be seen. Hemi-pharyngectomy was followed by an uninterrupted recovery, and microscopical examination of the portion removed showed a small malignant lesion. Similar retrogression occurs in a carcinomatous ulcer of the œsophagus after edentulation. The first step, therefore, in the treatment of any case of cancer of the œsophagus should be the removal of all teeth; or, if this is refused by the patient, the more infected ones should be removed and the

mouth rendered as clean as possible. The nasal sinuses should also be attended to.

The actual surface of the tumour may be treated with chemical substances. Mathieu recommends the use of sodium chlorate: he gives it in a cachet containing 1 gram of sodium chlorate with an equal quantity of lactose. Two or three cachets are given daily for two or three consecutive days. The patient experiences a burning sensation, and the dysphagia becomes worse for a day or two, but is then frequently improved. A similar effect is claimed by the same author to follow the use of half a gram of neutral bichlorhydrate of quinine with 1 gram of lactose, given in the same way.

4. **So-called Anti-cancerous Remedies.**—These have been used for a number of years in a large variety of cases, and consist of salts of copper, selenium, lead, gold, quinine, etc. They are prepared in what is said to be a colloidal state; but no conclusive evidence is to hand to prove that they are of real curative value. Intravenous injections of lead have recently been used, but experience at the Cancer Hospital, London, leads me to the firm opinion that we are not justified in recommending this form of treatment to our patients.

5. **Surgical Treatment.**

(a) Palliative Treatment.

(b) Radical Treatment.

PALLIATIVE TREATMENT

In cases in which the presence of metastases indicates that an attempt at radical operation would be futile, or in subjects so old or so enfeebled that a major operation could not be borne, recourse must be had to palliative treatment. I shall endeavour to show that life may be considerably prolonged and suffering alleviated by more generalized and systematic applications of modern methods of treatment, always bearing in mind that a radical cure is not unknown, and remembering Helsley's words, who states that "irrespective of the duration of the disease, the possibility of metastatic formation without evidence of the same should not be considered as a contra-indication to radical operation". It would appear probable that in the near future cancer of the œsophagus will have a mortality no higher than cancer of the breast or rectum.

Gastrostomy.—So far as I am able to judge, the majority of cases in this country are treated by gastrostomy alone. It is even no uncommon thing to see patients dying of thirst and starvation to whom even this alleviation has been denied, they having been told that nothing whatever can be done. Even the performance of a gastrostomy alone must be regarded as little short of masterly inactivity, and it is high time that we bestirred ourselves and expended much further effort to improve our technique with a view to active attack upon the disease of these unfortunate sufferers.

Gastrostomy may be performed moderately early in the course of the disease. If the patient is first seen in the earlier stages of the disease, and the case is considered operable, and the growth is known not to involve the stomach,

gastrostomy is performed. If the stomach is likely to be involved in the major operation, jejunostomy must be performed. Gastrostomy is a very useful preliminary to an attempt at radical removal, and is performed in the majority of cases, though not necessarily in all. By feeding the patient through the gastrostomy tube, his nutrition is improved before the operation, and also this allows the maximum of nourishment to be given after the operation without the obvious risks of feeding by the mouth.

If the case when first seen is considered inoperable, gastrostomy should always be considered, but not necessarily undertaken immediately. If the patient has not yet had difficulty with soft solids, and on œsophagoscopy is found to have a satisfactory lumen at the level of the growth, other palliative measures (*e.g.* radium) may be adopted before recourse is had to gastrostomy. Many of these cases will be found to improve so much that gastrostomy is postponed for many months, or even years, but in almost all cases gastrostomy becomes necessary sooner or later.

If a patient who is inoperable to radical operation has difficulty in swallowing soft solids when first seen, gastrostomy may be performed at once, unless the dysphagia has come on very suddenly. In these circumstances it is justifiable to wait for a few days to see if the sudden spasm can be relieved by antispasmodic treatment; but unless rapid improvement takes place the operation should be carried out. At about the same time the patient must be rendered edentulous, or as nearly so as he will allow. The teeth should be removed with the utmost care and gentleness, and with as little damage to gums and jaws as possible, preferably under a local anæsthetic, at either one or two sittings.

The performance of a gastrostomy has previously been described (pp. 47-49). It gives great relief and comfort to the patient, and if carried out according to the technique laid down is almost devoid of risk.

After the performance of a gastrostomy, retrograde œsophagoscopy may be undertaken, and is useful for two purposes: (1) to determine exactly the lower level of the growth; (2) to introduce radium seeds into the growth.

After feeding by the gastrostomy tube for a few days the spasm of the œsophagus disappears, and the patient is able to swallow comparatively well, because, when the constant irritation of the growth by decomposing food ceases, the superimposed œsophagitis subsides. For two or three weeks, at any rate, food is given by means of the gastrostomy tube, though water may be taken by the mouth.

As soon as the initial improvement in swallowing begins after the performance of gastrostomy, active palliative treatment of the œsophagus itself must be commenced. Patients are often so much improved that they think there is nothing wrong, and are apt to leave the care of the surgeon at this stage. Further palliative treatment may be carried out along one or more of the following lines.

Dilatation.—A further step is repeated dilatations of the stricture. This must first be performed under endoscopic vision, and in cases in which the

absence of diverticulum-formation has been determined may then be followed every week or two by the blind passage of graduated sounds. Each treatment is followed by a general improvement in the patient's symptoms, and although not an ideal treatment and not devoid of risk, it is of value when more modern methods are not available. It has been extensively used at the Mayo Clinic.

Intubation.—This may be done with considerable benefit and with more lasting effect than dilatation. It is generally known as Symonds' method. I prefer the use of a gum-elastic tube such as Symonds' or a short de Pezzer's tube such as Guisez's. The hollow tube may be left in position for several months, being prevented from passing through the stenosed area by a bevelled flange. It causes no inconvenience, though it may need occasional removal for cleansing. For many years this method was in disrepute, but with greater skill in œsophagoscopy, and a greater realization of the psychological value of chewing and swallowing food, it is rapidly regaining ground.



FIG. 102.

Symonds' tube.

This feature is an essential part of its value, and renders its passage, either upwards or downwards from the position in which it has been placed, a more difficult matter than occurs when a tube with smooth sides is used. The close spiral arrangement of the wire renders it very flexible; at the same time, it is quite incompressible, is very light, and occupies very little space. The upper end is expanded, this tending to prevent the tube from dropping into the stomach. This, however, has happened in several of my cases, but its extreme flexibility renders its presence in the alimentary tract devoid of danger, and in each case it has been passed to the exterior naturally.

The lumen of any of these tubes is large enough to allow any type of food which has been well masticated to pass through it. It may be left in position indefinitely, and a very striking improvement, not only in the patient's health, but in his mental outlook and general happiness, takes place.

Whatever type of tube is used the patients are usually quite unaware that any foreign body is present: no discomfort is produced. The patient must learn to masticate the food with great thoroughness, and swallowing becomes almost normal again. Any such tube simply canalizes the mass of growth.

A modification of Symonds' tube has been introduced by Souttar. This consists of a tube of coiled nickel or German silver wire. It is not quite cylindrical, but has a distinct irregularity of its lumen, as the accompanying illustration shows (Fig. 103). This feature is an essential part of its value, and renders its passage, either upwards or downwards from the position in which it has been placed, a more difficult matter than occurs when a tube with smooth sides is used. The close spiral arrangement of the wire renders it very flexible; at the same time, it is quite incompressible, is very light, and occupies very little space. The upper end is expanded, this tending to prevent the tube from dropping into the stomach. This, however, has happened in several of my cases, but its extreme flexibility renders its presence in the alimentary tract devoid of danger, and in each case it has been passed to the exterior naturally.



FIG. 103.

Souttar's tube.

The intubation of any malignant stricture, however, is a thoroughly unsurgical procedure, but the softer the material of the tube the less damage is it likely to do. I have used Souttar's tube in eight cases, in four of which it produced an œsophago-tracheal fistula with the resulting death of the patient within a fortnight.

Radium.—One of the most important modern methods of palliative treatment is the application of radium, and even several cases of cure are recorded, but only, as far as I know, by Guisez. The efficacy of this substance is still a matter of doubt. In the treatment of malignant disease generally, radium causes a regression of the growth at the site of application, sloughing is increased, and the infected glands at a distance are stimulated to increased activity unless they are also subjected to adequate radiation. The œsophagus, however, is unique in its position as an anatomical structure, and some of the contra-indications to radium may be waived: whilst it is not without a certain degree of danger, it frequently causes a great improvement in the patient's condition.

Radium may be applied to an œsophageal neoplasm (1) through an œsophageal catheter (Guisez's method), (2) under œsophagoscopic vision, (3) after exposure of the growth by mediastinotomy.

(1) When treating a patient by means of radium in an œsophageal catheter the following steps are undertaken:

(a) Measurement of the distance of the upper level of the growth from the incisor teeth. This should previously have been done both by radioscopy and œsophagoscopy.

(b) Measurement of the length of the growth by means of retrograde radioscopy (pp. 24 and 182), or retrograde œsophagoscopy (pp. 43 and 184).

(c) Preparation of the radium. The radium salt or its equivalent in emanation should be carefully screened by means of a platinum sheath 0.5 mms. in thickness, which thus allows the passage of only gamma rays. Second and

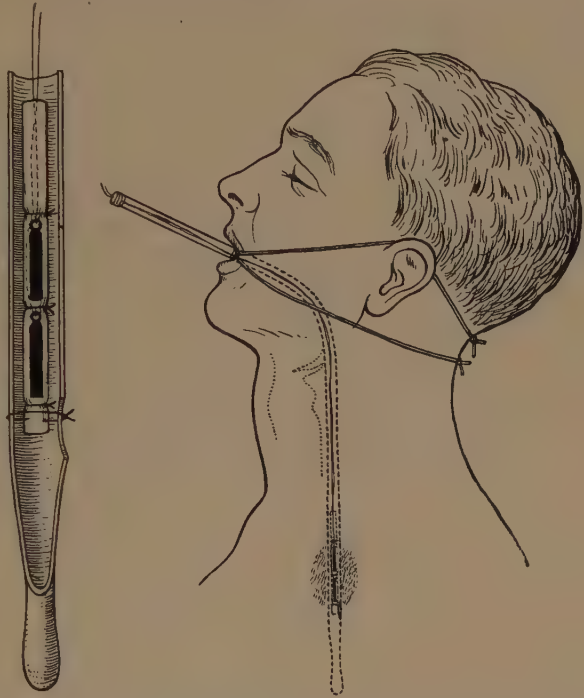


FIG. 104.—Diagram showing radium in œsophageal catheter and as applied to the tumour. (After Guisez.)

third sheaths, respectively of aluminium and of rubber, effectually stop all secondary radiations. The tubes should be long enough to more than fill the whole length of the stenosis.

(d) An œsophageal catheter is used which has been found to fit the lumen of the œsophagus accurately and comfortably at the level of the neoplasm. The previously prepared radium in its rubber sheath is passed into the catheter and sewn into it, and the catheter is replaced in the œsophagus in such a way that the whole length of the growth is subjected to irradiation.

If only a short sound or tube is used it is more than likely to be displaced upwards above the actual stricture and to come to lie in the dilated portion of the œsophagus. If any doubt as to the actual position of the radium is entertained it is advisable to make an examination by means of X-rays.

(e) Dosage and length of application. The dosage recommended is 100-120 mgs. of radium bromide, which should be applied on alternate days for some six to eight hours at a time, for a period of about two weeks.

An alternative method is to use a rather stronger dose for twenty-four to forty-eight hours at a time, but this is not so satisfactory as the repeated dosage method.

Hill uses as an ordinary standard 50 mgs. of radium bromide (approximately 25 millicuries) to each centimetre of length of the capillary tube, which fits into a silver or platinum screen. This he leaves in place for fifteen hours, and does not repeat the treatment for at least six weeks. His best case lived seven years from the first application, but eventually died from metastases.

Jackson is disappointed with radium. He finds that the patient grows rapidly worse from toxæmia, and that his life is shortened and made more miserable. He states that "this is in marked contrast to the very satisfactory effects of radium upon any other region of the body".

Guisez states that the most favourable type of growth to respond to the action of radium is that of slight extent, of the infiltrating variety with little proliferation. In his Semon Lecture, November 1924, reporting 270 patients treated by his method, he states that all were suffering from almost complete obstruction, and their expectation of life was estimated to be not longer than two to four weeks. He states that life was prolonged by from three to sixteen months, whilst in 30 cases the patients survived eighteen months or more, 4 of these dying from intercurrent affections and suffering no return of œsophageal symptoms. He has cases of definitely proved carcinomata of the œsophagus treated by radium in which no recurrence has taken place, 1 each eleven, ten, and five years after, 4 cases four years after, 4 three years after, and 12 more than eighteen months. From these figures it would appear that one case in nine treated by radium lives more than eighteen months, whilst one in twenty-five lives more than three years.

Whilst cure by radium is very rare, its great palliative advantages at the present time greatly outweigh its disadvantages, and its use is strongly recommended. My own experience of radium is in accordance with that of Guisez, and, when used by the technique which I have just described, two effects are

produced : first, the mechanical action of a tube left in place, which establishes a certain degree of permeability ; secondly, the actual destruction by the radium of the growth, which frequently appears entirely to vanish (Plate II. γ). A long remission may now occur : deglutition improves almost immediately ; hæmorrhages and foetid purulent secretions cease ; pain, if this has been present, disappears ; a great improvement in the general health takes place, and the patient may think that he is cured. It is, however, most important that he should be kept under observation, and, on subsequent œsophagoscopy, a scar is seen in the position vacated by the growth. After a short time a cicatricial contraction, with fibrosis, supervenes, and this demands careful dilatation. It is my practice to perform œsophagoscopy every four or six months on patients who have been treated by radium, and if any recurrence is seen, I repeat the treatment. In this way a patient may be kept free from symptoms for months or years, and a gastrostomy postponed for a very long time.

(2) Other workers, for example, Régaud, have performed actual puncture of the growth by means of radium needles or radon seeds. This is said to be most applicable to large fungating tumours, but has not been used very extensively.

(3) Recently several workers, who have attempted a radical removal of the growth and found it to be impossible, have left radium needles in the mediastinum in apposition to the œsophageal growth. I have done this on one occasion, but too recently to form any conclusions.

Diathermy.—Judging from the results obtained in cases of malignant disease of the mouth and pharynx, diathermy should have a certain usefulness when applied to the œsophagus.

I have had the opportunity of using this method of treatment in a few cases, and anomalous results have been obtained. Almost the whole of a projecting mass of growth can be caused to disappear and the permeability of the œsophagus may sometimes be restored by this method, but extensive fibrosis is likely to occur as a sequel, and a careful watch must be kept on the patient by means of endoscopy after the operation and stricture formation dealt with by dilatation. Patients who are submitted to diathermy should show no signs of involvement of the lungs or air-passages either by the growth or by infective processes. Repeated small hæmorrhages point to an extensive ulceration, and may at any time be followed by a large, or even fatal, hæmorrhage, and are to be looked upon as a contra-indication. In suitably chosen cases diathermy is of marked value ; but a fulminating mediastinitis or secondary hæmorrhage may make its appearance with fatal results.

Technique.—All cases of cancer of the œsophagus to be treated by diathermy must have a preliminary gastrostomy. The operation of diathermy is performed under direct vision by means of an œsophagoscope. The other electrode is placed beneath the spine or over the chest or abdominal wall, being separated from the skin by a thick pad of lint soaked in normal saline solution.

The area of operation having been carefully cleaned, the œsophageal electrode is passed down to the growth, the destruction of which commences

as soon as the electrical current is switched on. Any blood or mucus, and smoke, are withdrawn by continuous suction. From time to time the current is stopped and particles of growth and blood clots are removed by careful swabbing. If this is not done and the field of operation not kept well in view the whole time, there is danger of perforating the œsophagus.

The procedure is now repeated, and is continued until a sufficient area of growth appears to have been removed. The operator's aim should be, not to destroy a large mass at only the upper extremity of the growth, but to restore the lumen through or alongside the entire length of the growth. Even if this is only a very narrow canal and it is deemed advisable to stop, it is, at any rate, the basis on which to work at the next sitting. Any hæmorrhage should be controlled by means of fulguration before the œsophagoscope is withdrawn.

Subsequent to the operation, small clots of blood may come away from time to time for a few days and small masses of the growth may separate, but if the lumen has been restored in the manner indicated, they pass into the stomach.

Several days are allowed to elapse before food is given by the mouth. On the next examination the lumen is found to be a little larger than when the first treatment ceased, and after fourteen days no œdema or ulceration is present and the condition appears much improved.

Plate II., Figs. *u* and *v*, facing p. 152, show the degree of improvement in the local condition of a patient treated by diathermy.

The likelihood of secondary hæmorrhage is great, and is a drawback to all manipulation in such an infected viscus as the œsophagus, in which a raw area is left ripe for the development of sloughing inflammations.

Work along these lines is too scanty and too recent to allow of any dogmatic statement being made, and judgement must be reserved for the time being.

Deep X-ray therapy has been used in cases of carcinoma of the œsophagus and affords a certain amount of, though only temporary, relief. At Jackson's clinic, deep X-ray therapy, together with early gastrostomy, has proved the best palliative measure, many patients having lived two years from the onset of the disease, and one five years.

Of the methods of dealing with cases of inoperable carcinoma of the œsophagus the most satisfactory was, until recent years, by means of intubation. This, however, means an invariably fatal termination, and whenever possible radium should first be given a trial, for it would appear to have some actual cures to its credit. Failing this a gastrostomy should be instituted and treatment by deep X-ray therapy or diathermy undertaken.

CHAPTER XVII

CANCER OF THE OESOPHAGUS : TREATMENT—(*continued*)

RADICAL TREATMENT

THE problem of the cure of cancer as submitted to the surgeon calls for a radical removal of the disease. The first question in the discussion of any particular case of cancer is whether the condition is operable or otherwise. If, as far as human judgement can tell, it is considered in any particular case that a radical removal of the whole growth can be effected, this is always attempted where anatomical factors do not render it absolutely impossible. In this connexion might be mentioned a primary carcinoma of the liver, in which a radical removal would undoubtedly be followed by death. On the other hand, the removal of a lung for carcinoma or of an entire right cerebral hemisphere for gliosarcoma was looked upon as an impossibility until a few years ago, but has now been accomplished with success. Malignant disease of the rectum was in a similar position, with the possible exception of a few cases of early growth at its lower end, until abdomino-perineal excision was introduced. It is being realized more and more generally every day that early and complete removal of a malignant tumour affords the surest hope of cure.

Is the oesophagus to be placed in the category so recently inclusive of the rectum and lung in that every case is, *a priori*, inoperable? Hill says: "The operation . . . is so fatal as not to be worth attempting". I entirely disagree, and would rather say: "The *disease* is so fatal that, in the absence of any contra-indication, such as metastases or extreme emaciation, radical removal should always be attempted". When the enormous strides of major surgery in the last decade are considered, there would appear to be ample reason for leaving no stone unturned in the experimental laboratory with a view to exploring every conceivable method of dealing with the problem, and, further, endeavouring to apply these methods to human beings.

The fact remains that a proportion, and a fairly large proportion—according to some observers 70 per cent—of cases are surgically operable at the time when they are first seen by the medical practitioner, and some 30 to 50 per cent are operable when seen by the surgeon.

Radical Operation in the Cervical Region.—I should like to say that I owe most of my knowledge of this subject to the time I spent as dresser and house-

surgeon to Mr. Wilfred Trotter, to whom I am very grateful also for suggestions and help in my experimental work in connexion with the radical removal of the thoracic œsophagus.

It is now over twenty years since Mr. Trotter first utilized a skin-flap for the reconstruction of a pharynx of which a part had been removed for malignant disease; this method he had also used for the cervical œsophagus, and suggested for the thoracic œsophagus.

The chief dangers of operations upon the cervical œsophagus are: (1) *shock*, which is an inconspicuous factor, and easily combated; (2) *hæmorrhage*, which, although it demands attention, is not difficult to deal with; (3) *infection*, or so-called sepsis.

Infection.—The pharynx and œsophagus form a very special region in surgery with regard to septic infection, due both to the presence of the teeth and to the absence of any covering analogous to peritoneum. The healthiest set of teeth is no guarantee against the organisms which cause acute ulceration of the mouth, destructive ulceration of the fauces, or an ulcerative angina. There is, indeed, a distinct difference between infection occurring in patients with clean teeth, and that in those who have obvious caries or pyorrhœa; but it may definitely be laid down that acute sloughing inflammations are likely to arise unless the patient has been edentulous for some time. This particular variety of sloughing persists without suppuration for four or five days, and with only a slight rise of temperature, during which time a brownish slough covers the infected area. After this time the sloughs begin to separate, and suppuration occurs. If free drainage has been supplied, or the condition is recognized and the part opened freely, pus is discharged for about seven days; then granulations begin to form. It occasionally happens, however, that the infection spreads uncontrollably—not only in the neck, but even extending to the thorax. Another danger of the infected wound is acute septicæmia.

Secondary hæmorrhage frequently occurs in a manner of great interest, because of the dramatic, tragic, and disappointing way in which it appears; the patient may have no temperature and may appear to be progressing favourably up to any day between the fifth and tenth, when severe hæmorrhage occurs, and the blood may pass into the pharynx and give rise to asphyxia.

Method of Preventing Septic Complications. (1) *Condition of the Mouth*.—If the patient is edentulous and the mouth comparatively aseptic, sloughing inflammation very rarely occurs. If the patient is not edentulous, the prospect of having all the teeth removed is so formidable that the operation may be refused altogether. The rule, therefore, is that any obvious sepsis should be carefully attended to; if extensive extraction is agreed to and performed, four weeks must be allowed to elapse in order that the sockets may heal.

(2) *Treatment of the Wound*.—All wounds of the cervical œsophagus must be carefully stitched up and leave no raw surface, either (a) by bringing the divided parts together, or (b) by turning in a flap of skin from the surface. This is done for two reasons: first, to diminish the size of the wound and to

hasten convalescence ; and, secondly, to protect the wound as far as possible, and to help granulations to occur.

(3) *Drainage*.—If complete closure of the wound is not obtained, the freest drainage must be secured. Even if closure of the œsophagus is obtained, the area should be freely drained.

(4) *Care of the Lungs*.—The risk of aspiration of blood or infected material into the lungs during the operation must be abolished. This is best attained by means of an intratracheal anæsthetic, which may be administered through a tube passed through the nose or through the mouth or through a preliminary laryngotomy or tracheotomy. The last method I find to be the most satisfactory, as the pharynx may be completely plugged in the region of the epiglottis in order that no foreign material may find its way into the larynx and trachea. For the performance of the laryngotomy or tracheotomy I use my modification of Fuller's bivalve tracheotomy tube, which may be utilized with equal ease and safety either as a laryngotome or tracheotome. A sketch (Fig. 105) of this is shown and a description of the instrument and its use is as follows : One valve made of the hardest steel is rendered about a quarter of an inch longer than the other and the concave edge of this prolongation is ground to form a "scalpel-edge". All the remaining borders are rounded off in the usual way. The tip of the smaller valve is made to fit accurately into the groove of the larger valve of the instrument. The inner tube projects slightly beyond the outer, which then lies in close apposition to it, so that, with the inner tube in place, the "scalpel-edge" is thrown completely out of action.



FIG. 105.—Author's laryngotome and tracheotome.

The main object of the instrument is to do away with the time interval between the laryngeal or tracheal incision and the insertion of the tube.

As corollaries to this, it follows that the operation is performed without the aid of many instruments, with greater simplicity, and with the greatest possible speed.

Further, the instrument prepares and accurately fits its own incision and thus allows no escape of air or blood. The operation is therefore less dangerous to the patient and may be used in all cases in which the ordinary operation would be performed and in which any variety of tube would be used.

The instrument may be used without a preliminary skin incision, but manipulation is best and easiest after a small skin incision has been made. This may be either vertical or horizontal and need be only about half an inch in length. Through this incision the crico-thyroid membrane is palpated with the tip of the left index finger, while the remainder of the left

hand holds the larynx steady. The inner tube having been completely withdrawn, the rest of the instrument is then grasped between the finger and thumb of the right hand so that the smaller blade adjusts itself to the groove of the larger, leaving the scalpel-edge free to do its work. Its tip is now applied to the membrane and with a steady rotary movement an incision is made by passing the instrument backwards and downwards, describing the arc of a small circle. As soon as the tip of the smaller valve has been felt to pass the membrane no further incision is necessary, and the scalpel-edge must be prevented from doing any further cutting by inserting the inner tube completely into the outer tube. Immediately, the patient is heard to breathe freely through it, and all that remains is to push the instrument as far into the trachea as is necessary.

I use a tube not smaller than No. 26, and through this a fine catheter is passed into the trachea, and the anæsthetization continued through it, nothing but gas and oxygen anæsthesia being used.

TECHNIQUE OF OPERATION.—The operation consists of three stages: (1) Exposure; (2) Excision; (3) Reconstruction.

1. **Exposure.**—All plastic operations upon the cervical œsophagus demand the provision of a skin-flap (Fig. 106) in order that this may be used to restore the œsophageal continuity; otherwise the patient will develop a stricture. It is usually advisable to attack the growth from the right side of the neck, in order that manipulation may not be hampered by the thoracic duct. The exact position of the growth having been ascertained previously, and an estimate having been gained of the breadth of the flap required to restore the continuity of the gullet, a flap is made with its base either at the right or the left side of the neck and extending well beyond the mid-line. The next step, after hæmostasis has been secured, is to divide the

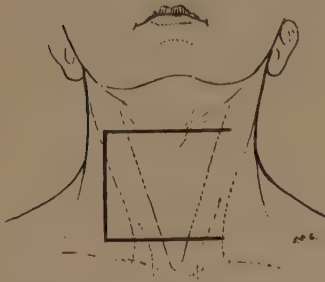


FIG. 106.—Diagram of position of skin-flap used in operations upon the cervical œsophagus.

deep fascia along the anterior border of the sterno-mastoid, and also to divide this muscle at its origin from the sternum and clavicle. The carotid sheath is now mobilized, after ligation of the inferior thyroid artery, and the prevertebral fascia and muscles discovered to its inner side. The anterior border of the sterno-mastoid is then sutured to the prevertebral region. The affected portion of the œsophagus is seen lying behind the trachea, with the prevertebral muscles and the sterno-mastoid behind and to the outer side. Very little blunt dissection is now required to separate the œsophagus from adjacent structures, and the region of the growth may then be carefully examined and the possibility or otherwise of radical cure determined. If the case prove favourable, the trachea, together with the thyroid gland and the recurrent laryngeal nerve, are retracted, and the whole region surrounding the area of proposed excision is carefully packed off with sterilized gauze, which may with advantage be moistened with a

solution of 1 in 500 perchloride of mercury. The next stage is to open the lumen of the œsophagus and thus expose the tumour to view. The surface of this must now be cauterized and carefully examined.

2. **Excision.**—With a small and early growth the incision around it must include three-quarters of an inch of apparently healthy œsophageal wall. In a larger growth this will mean the removal of a complete portion of the œsophagus with complete dissolution of its continuity.

3. **Reconstruction.** (Fig. 107.)—The flap of skin is now turned inwards and made to lie in the position vacated by the piece of œsophagus removed. By means of mattress sutures the skin is then united to the mucous membrane, the epidermal surface forming the interior of this plastic portion of the œsophagus, thus leaving a depressed and funnel-shaped opening which passes into the œsophagus. Through this opening a tube is passed into the lumen of the œsophagus. From the upper and lower edges of the field of operation pieces of gauze are left projecting, together with one or more drainage tubes; the function of the latter is to provide free egress for any leakage from the œsophagus, and therefore to diminish the possibility of the development of cellulitis; whilst the function of the former is to hasten the development of granulation tissue. The patient must be attended constantly for at least one hour, but preferably longer, in order to make sure that the intra-œsophageal tube is neither vomited nor withdrawn by him. After the first hour or two of consciousness after recovery from the anæsthetic it can easily be tolerated by the patient.

It is sometimes thought advisable to pass a tube from the lateral aspect of the neck not only downwards into the œsophagus but upwards into the pharynx. Some authorities, however, pass a tube through the mouth, the pharynx, and the newly-formed plastic part of the œsophagus into the œsophagus proper. Once the patient has recovered from the anæsthetic, this is usually well tolerated.

The Treatment of the Lymphatic Glands.—At the time that the original skin-flap is raised both sides of the neck come within the surgeon's reach, and the paratracheal, para-œsophageal, and inferior deep cervical glands are exposed, and may be removed. This must, of course, be done on both sides of the neck.

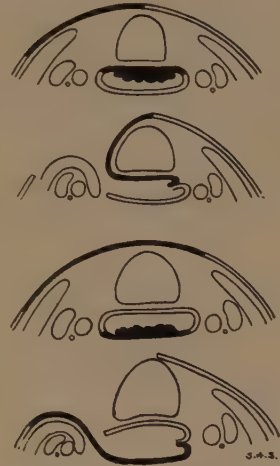


FIG. 107.—Diagram of formation of skin-flap in repair of cervical œsophagus after partial excision for carcinoma. (After Trotter, slightly modified.)

SURGICAL APPROACH TO THE THORACIC ŒSOPHAGUS (POSTERIOR MEDIASTINOTOMY)

We now pass to the treatment of those cancers of the œsophagus which are situated in the lower three-fourths of the gullet. In order to reach those

in the middle two-fourths, posterior mediastinotomy must be performed, while the lowest fourth may be approached either by this route or by abdominal laparotomy.

Preliminary Considerations.—A few words are necessary here with reference to thoracic surgery in general. The patient must be examined to ascertain whether he is fit to stand a serious operation. If he is emaciated and the tissues are suffering from marked dehydration, a gastrostomy or jejunostomy must be performed from seven to fourteen days before the major operation.

Blood Pressure.—The patient's dehydrated state having been successfully combated, the next point which requires attention is the blood pressure. If this is less than 125 mm. Hg (systolic), treatment must be instituted until it reaches this pressure. The percentage of hæmoglobin should not be less than 60; if it is, a blood transfusion should be performed, using 500 c.cms. of blood from a suitable donor, forty-eight hours before the major operation. The coagulation time of the blood should be tested, and, if this is found to be less than seven minutes, an intramuscular injection of 30 to 40 c.cms. of a sterile solution of sodium citrate in water should be given at the commencement of the operation. The bowels should be moved forty-eight hours before, but no nearer to, the operation. Special attention must be paid to the sterilization of the skin, remembering that a small furuncle may infect a whole wound.

Anæsthesia in Thoracic Surgery.—Major procedures within the thorax rank highest in that operative success depends upon the skill of the anæsthetist and the efficacy of the method of anæsthesia employed. Narcosis should be maintained by means of a nitrous-oxide-oxygen combination, using only a little ether at the time of induction until the intratracheal or endopharyngeal tube has been satisfactorily adjusted. By either intratracheal or intrapharyngeal insufflation a positive pressure may be maintained in the lungs, so that if the pleura is opened—as is often the case in exploration of the thorax—none of the ill-effects of an acute pneumothorax will make their appearance.

The Pleura.—One must bear in mind that it is extremely easy to infect the pleura, and therefore that operations designed to effect partial or total œsophagectomy which do not entail opening the lumen of the gullet *in situ* are more likely to be successful than those where immediate section of the organ is performed.

Even with prolonged exposure alone a considerable quantity of serous exudate is produced by the pleura during the first twenty-four to forty-eight hours after the operation. The lungs must therefore be fully inflated before the last stitch is tightened in order that adhesions may form rapidly, and if the time of the operation has been long a water-seal drainage should be used. Fig. 108 shows the arrangement of this after Kenyon's method, together with a bottle to catch the discharge. The drainage tube must fit tightly into the thoracic wound, and must not project more than an inch into the pleural cavity.

Post-operative Shock.—A greater or less degree of post-operative shock is bound to occur, and I am a firm believer in taking steps to combat or prevent this

before it makes its appearance. Already the patient has been rendered as fit as possible for the operation. When this is over, blood transfusion is our greatest aid, and should be performed even if it was done before the operation.

A simpler method, and one which I have used in a large number of major operation cases, including mediastinotomy, is to give an intravenous injection of 15 per cent glucose in either normal saline or sterile water together with 20 to 30 units of insulin intramuscularly. At the same time a subcutaneous injection of oxygen is given into the upper and outer aspect of the thigh, using from 500 to 1000 c.cms. (Bayeux ; McDonagh).

Rectal injections of saline with 10 per cent glucose are of great value, as

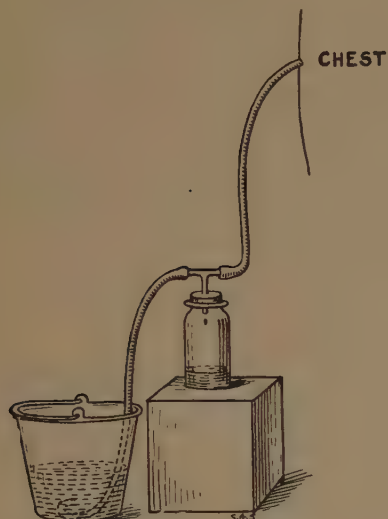


FIG. 108.—Kenyon's method of water-seal drainage.



FIG. 109.—Diagram showing position of incision for skin-flap for reconstruction of thoracic oesophagus.

is also hypodermoclysis. Morphine has also a distinct place in this treatment and successfully combats pain and restlessness.

Technique of Posterior Mediastinotomy.—When this operation is undertaken for the relief of cancer of the thoracic oesophagus situated above the lower two or three inches of the gullet, the incision must always be planned with a skin-flap of sufficient size to enable this to be passed around the tumour-bearing area of the organ.

If the growth is situated at or above the level of the aortic arch the incision is made on the right side of the back of the thorax. If below this level, it is made on the left. Lilienthal gives the following precautions: (1) Make sure of the position of the growth, and that you are operating on the correct side. (2) Place the patient in the best position at the beginning of the operation. (3) During the operation a blood-pressure apparatus should be kept adjusted and frequent readings taken. This will give warning of impending collapse before any other signs are evident. (4) Therefore plan the operation



FIG. 110.—Diagram showing muscles exposed when skin-flap is dissected up.



FIG. 111.—Posterior mediastinotomy; three inches of one rib have been removed, and three other ribs have been divided close to their junction with the spine. (From an actual operation.)



FIG. 112.—Posterior mediastinotomy; the shingled ribs are retracted and the pleura is being carefully stripped away from the mediastinum. The hands are drawn small in proportion. (From an actual operation.) (After Lilienthal.)

so that it can be stopped if the patient collapses, and continued at another sitting, the first stage having for its object the formation of adhesions, which diminish the complications due to the interference with the normal thoracic mechanism and thereby greatly reduce operative danger. Operations for the cure of cancer in the lower two or three inches of the œsophagus will be described later. I will now describe a left-sided partial œsophagectomy in detail.

The patient is placed in the right semi-prone position.

The incision (Fig. 109) starts two inches above the level at which the growth is known to be, and extends from the mid-line outwards along the line of the subjacent rib for some five to seven inches. It then turns with a rounded-off corner vertically downwards for five to six inches; then towards the mid-line again parallel to the first incision. This flap, including skin and subcutaneous fascia, is now dissected up from the underlying structures (Fig. 110), and wrapped in warm moist cloths. As much of the trapezius muscle as is exposed is then detached from its origin and reflected upwards and protected with cloths. The latissimus dorsi is either retracted, or, if much of it is exposed, it is dealt with in like manner.

The posterior aspects of five or six ribs are thus exposed, covered towards the mid-line by the vertically placed tendons and fibres of the erector spinæ. This I now divide between clamps in a transverse direction at the upper and lower extremities of the wound, thus making a muscular flap which is turned towards the opposite side of the body and lies with the original skin-flap.

Three or four inches of the lowest rib exposed are now resected subperiosteally, the inner section of rib being as near the transverse process as possible (Fig. 111). The underlying pleura is exposed but not opened, and extreme care and gentleness are now required to press the pleura away from the under surface of the rib above. When this has been done I inject the intercostal nerve with absolute alcohol for anoci-association purposes, and then section the rib as near the transverse process as possible. It may now be retracted upwards and outwards by the assistant. The pleura is pressed away still further, and, in all, three or four ribs may be dealt with in this way. This is known as shingling the ribs. The accompanying diagram shows the result obtained (Fig. 112). The intercostal arteries must each be tied at both ends as each rib and artery is severed.

A strong rib-retractor, for example, Tuffier's (Fig. 113), or de Quervain's (Fig. 114), is necessary. On occasion I have used Thomson - Walker's three-way bladder-retractor. This is powerful enough for the purpose, and at the same time allows a light to be fitted on to the middle blade which illuminates the interior of the thorax and makes identification of the structures very easy (Fig. 115).

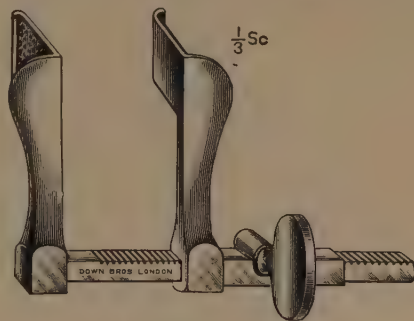


FIG. 113.—Tuffier's rib-retractor.

In order that the blades may not damage the pleura, I protect this by cloths

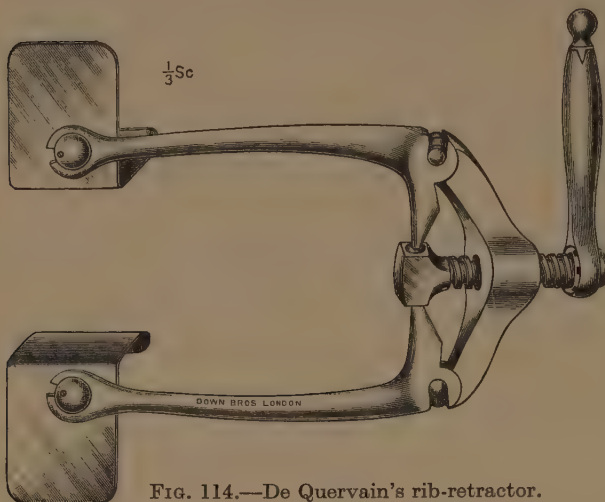


FIG. 114.—De Quervain's rib-retractor.

pleura; this is not a matter of difficulty. A little further stripping now reveals the œsophagus. In order that its identification may be rendered easy, a sound may be passed into it from the mouth, or, better still, Lilienthal's electric diaphane used; this is simply a small electric bulb attached to a rubber sound, which transilluminates the œsophagus.

If preliminary investigations have been carried out accurately, the tumour is readily found, and its operability—or the reverse—may now be ascertained. If it is operable, matters should then proceed as follows: Two or three of the retracted ribs should be divided some three inches from the site of the primary division, thus making three or four ribs in all, portions of which have been removed. The fibres of the vagi which are seen forming the plexus gulæ are divided with scissors, and the proximal ends swabbed with a small quantity of 2 per cent cocaine. The œsophagus is now separated from the loose cellular tissues in which it lies by means of

wrung out in a $\frac{1}{2}$ per cent solution of novocain. This helps to diminish the powerful pleural reflexes, and is especially useful if the pleura has been opened. The pleura lining the lateral aspects of the bodies of the vertebræ is carefully stripped from them, and the aorta readily comes into view. Before this is reached a little care must be taken not to remove the sympathetic and splanchnic nerves with the retracted



FIG. 115.—Posterior mediastinotomy; the pleura has been stripped from the mediastinum, and the aorta and the cancer-bearing area of the œsophagus are exposed. A light on the middle blade of the retractor illuminates the field of operation, and an electric diaphane transilluminates the œsophagus. (From an actual operation.) See also Fig. 116.

blunt dissection or by means of an aneurysm needle curved at right angles which is carefully manipulated all round it until the gullet is lying free for some inches above and below the level of the growth.

If at this stage the growth is found to be inoperable a barrage of radium needles or of radon seeds may be applied to it.

In my animal experiments I pass the free portions of the trapezius above, the latissimus dorsi below, and the erector spinæ to the inner side, deep to the œsophagus, and suture these together with two or three interrupted catgut sutures so that the tumour-bearing area of the gullet is lying in the bed so formed (Fig. 117).

In a similar way the skin-flap is also placed anterior to—that is, deep to—the œsophagus, and sutured as nearly as possible to the skin of the back from which it was originally divided, thus closing off the mediastinum from the

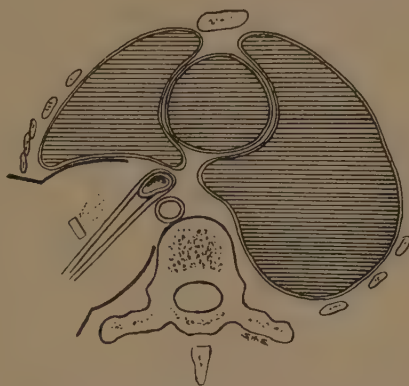


FIG. 116.—Diagram showing relationship of structures with œsophagus isolated by posterior mediastinotomy. (After *Lilienthal*.)

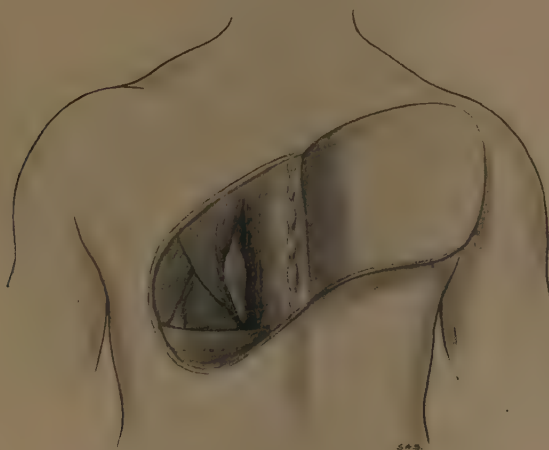


FIG. 117.—The œsophagus is lying in the newly-formed muscular bed.

skin of the back completely, or perhaps with a small gap at the outer part of the wound (Fig. 118). This is now closed by means of a small flap turned

up from below, and the operator's aim should be to bring skin-edge to skin-edge except where the œsophagus edge passes through.

As already stated, the lungs are carefully distended by increasing the

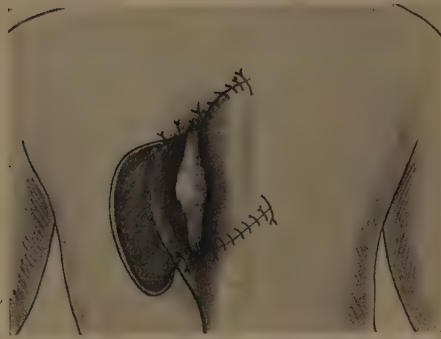


FIG. 118.—The plastic skin-flap is shown lying deep to the œsophagus.

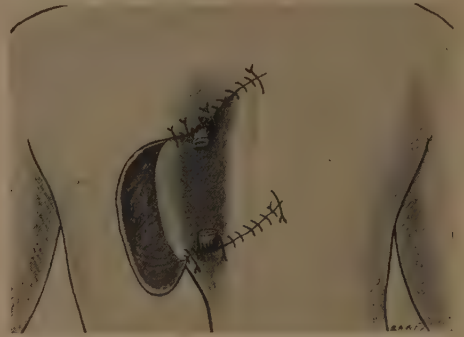


FIG. 119.—The cancer-bearing area of the œsophagus has been removed, and the flap may now be utilized to form the new œsophagus. The black line below in this and the preceding diagram shows the incision required for drawing up skin to fill the raw muscular space.

pressure in the anæsthetic tube before the last stitch is drawn tight. If considered necessary, a water-seal drainage tube is also inserted into the thorax

before the wound is finally closed. We now have the growth and an adjacent one and a half to two inches of normal œsophagus on each side of it lying at the bottom of a groove in the back.

I have performed this operation upon eight animals with success, and have not found gangrene or rupture of the œsophagus occur.

Some seven to ten days later the cancer-bearing area of the œsophagus is removed with as much normal tissue as feasible on each side of it (Fig. 119). This, I would suggest, should be at least one inch in extent, and more if possible. The sutures are

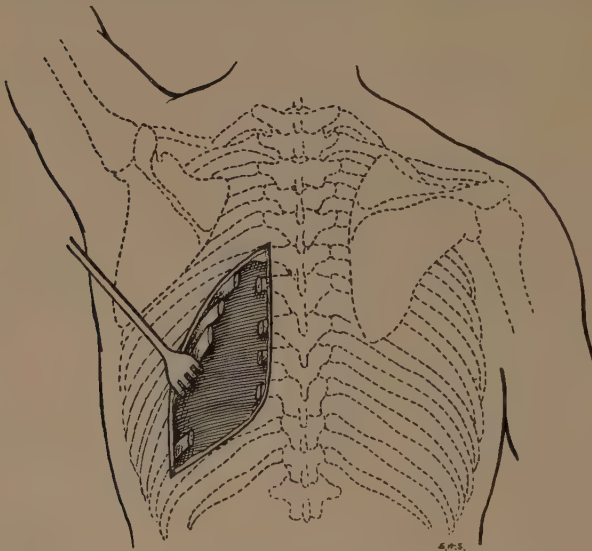


FIG. 120.—Torek's incision for low posterior mediastinotomy or Lilienthal's operation. (After Lilienthal.)

removed from the skin-flap, and it is separated from its base after infiltration with novocain. The inner and outer edges are dissected up and united to

each other, while the upper and lower ends of the cylinder of skin thus formed are united to the upper and lower ends of the œsophagus respectively.

Lastly, the remaining inner and outer edges of the skin wound are undermined and drawn together, thus rendering the newly-formed œsophagus subcutaneous. Drainage tubes should be left in place for two or three days in case any leakage occurs.

I have performed posterior mediastinotomy upon three men and one woman with a view to radical removal of a growth of the œsophagus, but was unable to mobilize the œsophagus on account of fixity of the growth. Two men had peri-œsophageal abscesses which were opened during the operation, and they succumbed to mediastinitis in fifteen hours; the other two cases made an uninterrupted recovery from the operation, and were subsequently treated by palliative measures.

Operations for Radical Removal of the Lower Two or Three Inches of the Œsophagus. 1. By Mediastinotomy.—If gastroscopy has shown that the adjacent portion of the stomach is not affected the operation is best performed through a low left-sided posterior mediastinotomy; in this case a flap need not be raised, but the incision is made commencing some two inches from the mid-line opposite the middle of the vertebral border of the scapula, extending vertically downwards to the tenth intercostal space, and then laterally along the line of this intercostal space for from five to six inches. The underlying muscles are retracted in the manner already described, and three to four inches of the tenth rib removed. The ninth, eighth, and seventh ribs are now shingled as before (Fig. 120). The pleura and lung are carefully retracted, and the lower few inches of the œsophagus and the upper surface of the diaphragm, including the œsophageal opening, are exposed. By means of blunt dissection the œsophagus is separated from the diaphragmatic opening, which is now incised towards the left and enlarged sufficiently to allow the cardiac region and fundus of the stomach to be



FIG. 121.—Lilienthal's operation. The lower two or three inches of the œsophagus have been removed and an opening made into the stomach. A needle bearing two long threads is passed from below through the main gastric opening to reach the œsophagus. (*After Lilienthal.*)

drawn into the field of operation. At least one inch above and below the growth, the œsophagus is divided by means of the actual cautery, between clamps, the whole area being carefully protected by means of cloths. The opening thus made into the stomach is now closed and invaginated. Then the fundus of the stomach is drawn upwards so that it easily reaches one inch above the lower end of the remaining portion of the œsophagus, and an incision large enough to admit the œsophagus is made into it. About one and a half inches below this incision a smaller incision is made into the stomach. Through



FIG. 122.—Each of the two threads is cut, and the four threads thus obtained inserted through the œsophagus at equidistant points. These threads are now utilized to intussuscept the œsophagus into the stomach. (*After Lilienthal.*)

the latter a needle bearing two long pieces of suture is passed, emerging again through the larger and upper opening (Fig. 121). The sutures are drawn through the larger opening and cut, so that four sutures are now available. Each of these is re-threaded on to a needle and passed through the wall of the œsophagus at four equidistant points (Fig. 122). Traction is now made upon these sutures and the œsophagus is drawn into—that is, intussuscepted into—the stomach, where it is retained by means of two or three sutures which pass through the wall of the stomach and œsophagus (Fig. 123). The traction sutures are then cut short and allowed to hang freely in the stomach, the smaller incision into which is closed by a stitch. The region of the stomach into which the œsophagus has been inserted

is now still further invaginated by a series of Czerny-Lembert sutures (Fig. 124). It is most important that the stomach should be united to the diaphragm where this is pierced; otherwise a large diaphragmatic hernia may develop. I have performed this operation successfully upon a dog, but unfortunately neglected to suture the stomach to the diaphragm, and the animal succumbed nearly twenty-four hours later owing to a considerable amount of the abdominal contents passing into the thorax. Post mortem, the œsophago-gastrostomy was found to be perfect, and did not leak even under considerable pressure. This operation was devised by Lilienthal, and its extent is shown diagrammatically in Fig. 125.



FIG. 123.—The œsophagus is maintained in position by three sutures, and the smaller opening into the stomach closed. (After *Lilienthal*.)



FIG. 124.—The region of the œsophago-gastric junction is invaginated and the stomach sutured to the diaphragm. (After *Lilienthal*, slightly modified.)

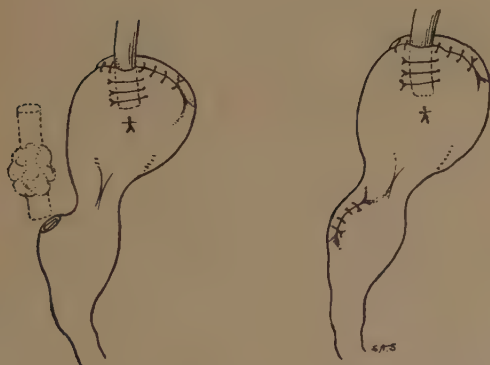


FIG. 125.—Diagram showing extent of *Lilienthal's* operation. (After *Lilienthal*.)

2. By Abdominal Laparotomy.—Cases of cancer of the œsophagus arising at the cardia, whether primarily œsophageal or primarily gastric in origin, usually demand an abdominal laparotomy in order that their operability may be determined. If a jejunostomy is done as a preliminary operation, the possibility of a radical removal must be estimated at the same time, and, if it is found that an extensive resection of stomach as well as removal of the



FIG. 126.—Diagram showing a method of removing a growth at the lower end of the œsophagus.

abdominal portion of the œsophagus is feasible, this may be performed entirely by the abdominal route (Fig. 126).

Technique.—An incision is made half an inch below and parallel to the left costal margin, extending well round to the back. The layers of the abdominal wall are divided in the line of the original incision, and the field of operation is exposed. The table is tilted so that the patient's head is at a higher level than his feet, and a large retractor is passed beneath the costal margin and used to pull this well upwards. If the area

of operation is not thus rendered easily accessible, the lower two or three ribs must be divided through the posterior part of the original incision. This now allows a satisfactory view of the fundus of the stomach, the cardia, the abdominal portion of the œsophagus, and the œsophageal opening in the diaphragm. By means of blunt dissection the œsophagus is separated from the diaphragm, and a finger is passed into the mediastinum, separating the œsophagus still further from the loose cellular tissue around it. A previous X-ray examination may have shown dilatation or tortuosity of the œsophagus, and gives a pre-operative idea as to whether a sufficient length of this organ could be drawn downwards into the abdomen. It may, however, be advisable in either this operation or in that of Lilienthal to perform a section of the left phrenic nerve in the neck as a preliminary measure in order to paralyse the left side of the diaphragm and therefore render access easier. When a sufficient length of the gullet has been drawn below the diaphragm a rubber tube is passed round it at the cardia, and acts as a retractor. The œsophagus is now sutured by one or two stitches to the highest portion of the fundus of the stomach about two inches above the upper limit of the growth. One small opening is made into the stomach just below these sutures, and another into the œsophagus. A continuous suture is now passed through all the walls of both viscera, taking up the posterior edge of the upper portion of the partially sectioned œsophagus. When this has been included in the suture the œsophagus is cut across a little further and the suture continued, and little by little the œsophagus is completely sectioned until, when this has been accomplished, the posterior half of its wall has been sutured to the posterior edge of the opening in the stomach. All that remains is to pass a suture uniting the anterior part of the walls of both viscera. On each side of the anastomosis a sero-muscular gastric suture is now made, causing an invagination of the anastomosed area. The lower end of the œsophagus and adjacent stomach are then removed as widely as possible, and the opening thus made into the stomach is closed and inverted in the usual way. I have three times set out to perform this operation on patients, but on each occasion found that, although the œsophagus could be withdrawn sufficiently into the abdomen, the gastric condition had advanced beyond the possibility of a radical removal. I have, however, done the operation twice upon a cadaver with a watertight result.

Another operation I have performed upon the cadaver which should, I think, be quite feasible upon the living is as follows: The abdomen having been opened as just described, and the œsophagus mobilized and the tumour found to be operable, an incision is made into the stomach about its middle, extending almost from the lesser to the greater curvature. A finger is now passed into the cardia, which is drawn through the gastric opening—that is to say, the lower end of the œsophagus and adjacent stomach are intussuscepted into the remainder of the stomach—and the tumour drawn outwards through the gastric incision. A clamp is then applied a good inch away from the growth, which, together with the adjacent œsophagus and stomach, is removed by

means of a cautery. Three or four sutures are passed between the non-intussuscepted portion of the œsophagus and the serous wall of the stomach at the site of intussusception.

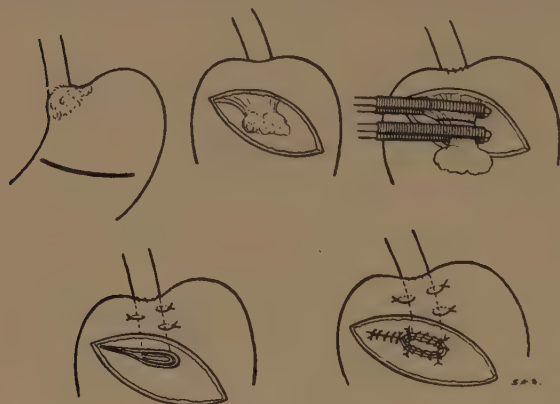


FIG. 127.—Diagram showing another method of removal of growth at the cardia.

Now, passing to the area where the œsophagus and stomach have been sectioned, the two are united by means of through-and-through sutures, extra sutures being passed in order that the left gastric artery may be securely ligated. Two or three sutures are also passed through the walls of the stomach, picking up the intussuscepted portion of the œsophagus. The gastric opening is then closed in the usual way (see Fig. 127).

Combined Operations. *Mediastino-cervical Operation.*—In Torek's famous case, which was demonstrated alive and well in New York twelve years after



FIG. 128.—Torek's operation. Posterior mediastinotomy, with division of the œsophagus *in situ*. (After Torek.)



FIG. 129.—Diagram showing line of incision for exposure of the cervical œsophagus.

operation, he performed a posterior mediastinotomy with section of the œsophagus *in situ* and invagination of the lower end (Fig. 128). An incision was then made in the neck (Fig. 129) and the upper portion of the œsophagus containing the tumour drawn through this incision (Fig. 130) and passed under

the skin of the anterior wall of the thorax, so that it emerged through an incision in the skin at the level of the second intercostal space. The protruding portion of the œsophagus, including the growth, was removed and later one end of a rubber tube inserted into the now subcutaneous œsophagus, its other end entering a previously prepared gastrostomy.

Eggers, of New York, has also had a successful case.

An *abdomino-cervical operation* has also been performed: the stomach is mobilized after the method of Kirschner, and the œsophagus separated from its diaphragmatic hiatus. The œsophagus having been exposed by the cervical route, it is drawn upon until almost the whole of it emerges through the neck, the stomach coming to lie in the posterior mediastinum (Fig. 131). The tumour-bearing area is now excised, and the gullet sutured and replaced into the neck.

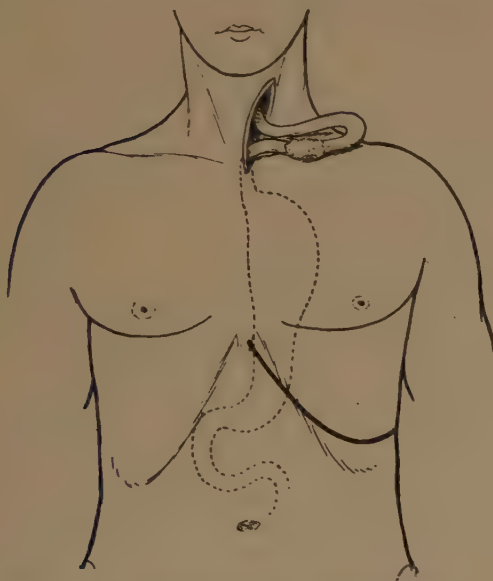


FIG. 131.—Diagram showing exteriorization of the œsophagus through a cervical incision, with displacement of the stomach into the thorax after mobilization.

I have performed this operation upon a dog, but consider it of doubtful value in a case of cancer of the œsophagus, when so many much more satisfactory operative procedures are open to us.

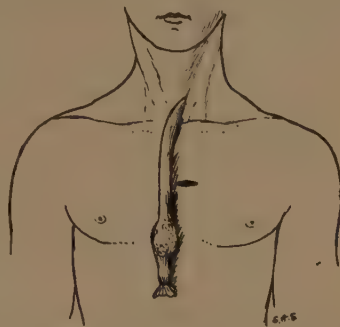


FIG. 130.—The œsophagus with-drawn through the cervical incision in Torek's case. (After Torek.)

Another *abdomino-cervical operation* which has been suggested consists in first exposing the cardia by laparotomy and dividing the œsophagus from the stomach. The gastric opening is closed. A malleable sound is now passed from the mouth to the lower end of the œsophagus, to which it is secured by means of a stout thread. The end of the gullet is surrounded by oiled silk, which is tightly tied round it, the ends of the ligature being left long.

Through a cervical incision the œsophagus is exposed, and when traction is made upon the peroral sound the lower part of the œsophagus is intussuscepted into the upper (Fig. 132) and the long ligature appears in the neck. It is withdrawn through the cervical wound, and the whole œsophagus, together with its growth, exteriorized.

Abdomino-thoracic Operation.—Levy, of Berlin, suggests Friederich's operation of subperiosteal excision of the last six ribs, thus causing collapse of the thorax so that the œsophagus can easily be reached. The diaphragm is then divided and transplanted upwards. Both the œsophagus and the stomach are now lying close to the skin, and the affected area may be excised, leaving

the cut ends of the œsophagus and the stomach extra-cutaneous, where they may later be anastomosed. A modification of this method was successfully used by Hedblom, and also by Zaaier.

Conclusions.—As already stated, cancer of the œsophagus gives early symptoms. Further, this particular type of tumour remains localized to the affected organ long after its presence can definitely be diagnosed. Thirdly, glandular metastases from carcinoma of the œsophagus are the exception rather than the rule, and the majority of sufferers from this complaint do not die from carcinoma but from starvation.

It would thus appear that cancer of the œsophagus often is, and almost always should be, diagnosed at a very early date; that its surgical removal should be followed by complete freedom from local recurrence; and that later glandular recurrence should occur only in the minority of cases.

I am strongly of opinion that the operations suggested are feasible. It will be remembered how Billroth began operating on the stomach some fifty years ago; many of his patients died, but to-day operations on the stomach are performed by all surgeons with extremely low mortality, and yet our operations and those of Billroth are the same except for very small points of technique. Similarly with growths of the large intestine; at the beginning of the present century these were looked upon as inoperable, whereas at the present time their removal is an everyday occurrence.

With more adequate education and earlier investigation of cases, and the application of the principles which I have enunciated, there would appear to be no reason why malignant disease of the gullet should not be treated so effectively that before long, instead of claiming virtually 100 per cent of its victims as it does at the present time, it will be the most favourable type of cancer with which the surgeon has to deal.

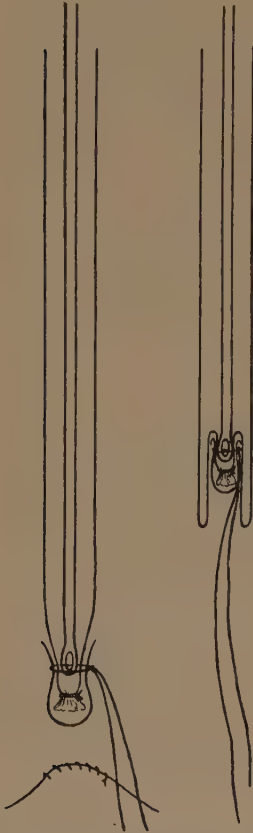


FIG. 132.—Diagram showing a method of displacement of the œsophagus by means of a sound passed through the mouth.

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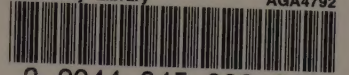
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